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ORIGINAL MEMOIRS.

THE SURGERY OF THE PANCREAS.*

I. INJURIES TO THE PANCREAS IN THE COURSE OF OPERATIONS ON THE STOMACH.
II. INJURIES TO THE PANCREAS IN THE COURSE OF OPERATIONS ON THE SPLEEN.
III. RESECTION OF HALF THE PANCREAS FOR TUMOR.

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THE deep situation of the pancreas renders it difficult to obtain correct knowledge of its diseases during life. The little knowledge which is obtained is due chiefly to the individual experience of various surgeons and to experimental investigations.

The pancreas is derived from two or three buds from the foregut and early in fetal life is an intraperitoneal organ. When rotation takes place the pancreas is turned on its right side, losing its posterior peritoneum, which becomes converted into fibrous tissue. Possibly the diffuse character of fat necrosis both within and without the peritoneal cavity from pancreatic perforation can be accounted for in this way.

The pancreas receives its blood supply from five or six different sources, the most important of which are the superior pancreaticoduodenal, the inferior pancreaticoduodenal, the inferior pancreatic and the branches that are derived from the splenic artery as it runs behind the superior border of the body of the pancreas. The lymphatics of the pancreas

* Read before the American Surgical Association, May 8, 1913.

are not collected in one group but follow the vascular supply—an important fact in connection with the causation of pancreatitis, as pointed out by Deaver.[1]

The pancreas has no true capsule but, when irritated, one quickly forms from the peritoneum and those tissues derived from the peritoneum (Fig. 1).

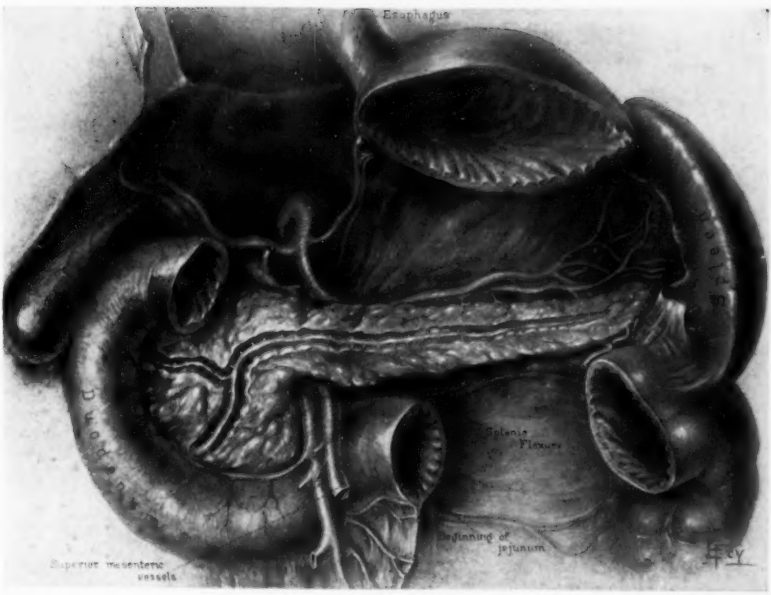
The pancreas is hidden by the liver, duodenum, transverse colon and especially by the stomach. The two latter organs vary in position to a considerable extent. Access to the pancreas for operative purposes is usually best obtained through the gastrocolic omenta, drawing the stomach upward and the transverse colon downward. The pancreas, especially the head, is usually fixed in position, but it may be more or less movable in the body and tail. During routine abdominal operations patients are occasionally seen in whom the pancreatic attachments are so loose that the pancreas as a whole can be drawn outside the abdominal cavity.

I. INJURIES TO THE PANCREAS IN THE COURSE OF OPERATIONS ON THE STOMACH.

Haberkant[2] reported a mortality of 76 per cent. in his cases of resection of the stomach for cancer in which there were pancreatic attachments resulting in injuries to the pancreas. Mikulicz[3] found a mortality of 70 per cent. in his cases when the pancreas was injured as against 27.5 per cent. when it was not injured. In 448 resections of the stomach for benign and malignant diseases up to Dec. 31, 1912 (W. J. and C. H. Mayo) the average mortality was 10 per cent. In about 8 per cent. of these cases the pancreas was injured and the average mortality was 11 per cent.

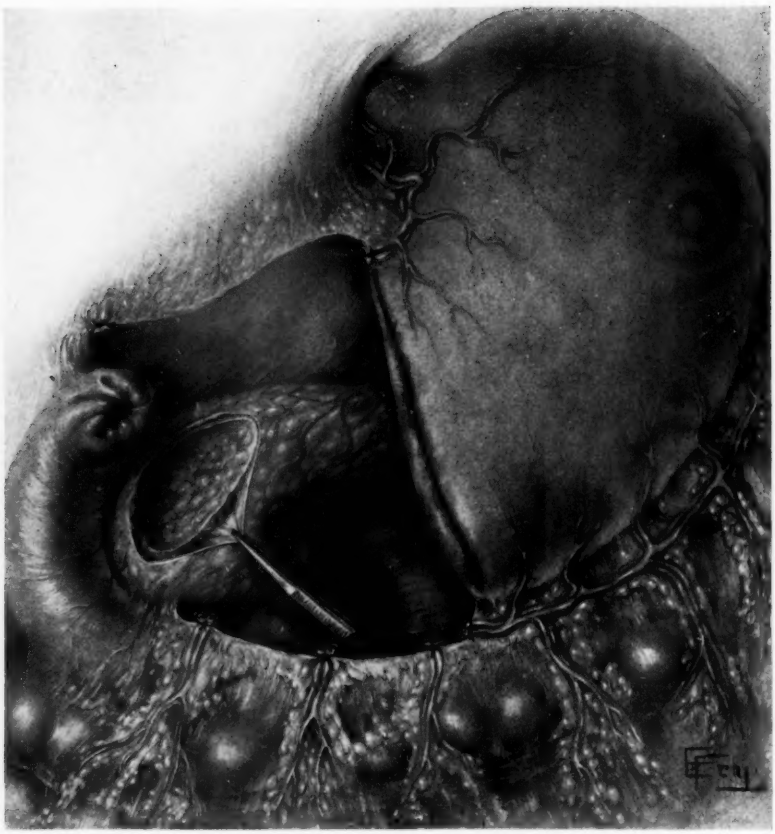
In none of these operations, however, was the main pancreatic duct reached, usually only a superficial piece was removed from the surface at a point where the pancreas was adherent to the diseased stomach. The bleeding was usually free and best controlled by catgut on a curved needle. It was noted that in these cases the pancreas had a fibrous capsule, the result of the localized peritonitis.

FIG. 1.



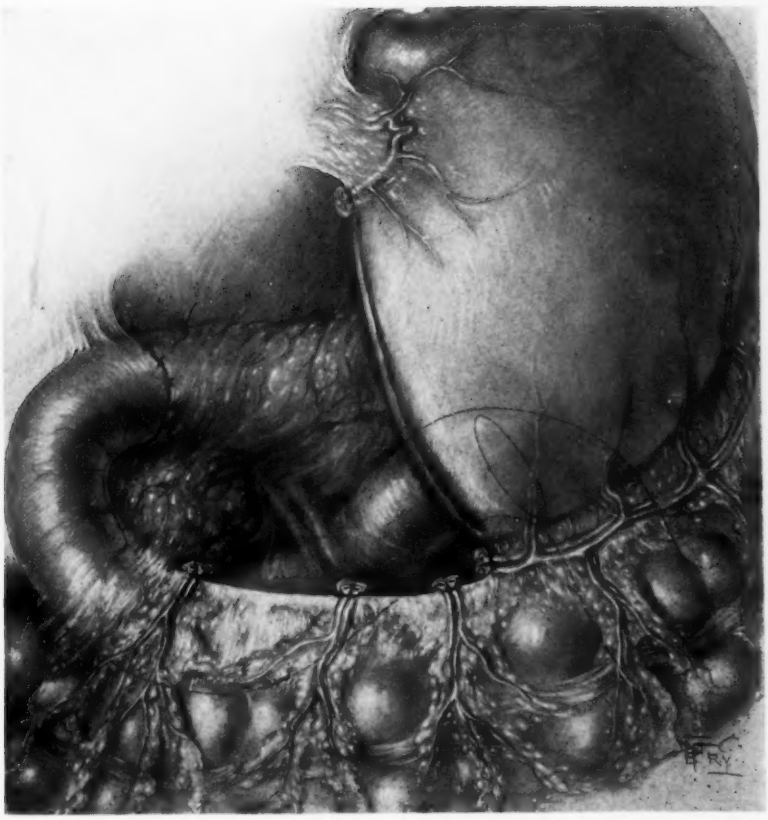
Showing anatomy of pancreas and its anatomic relations.

FIG. 2.



Showing excavation in pancreas following resection of pyloric end of stomach with pancreatic involvement. The end of stomach and end of duodenum both closed.

FIG. 3.



Showing operation completed. Closed end of duodenum buried in excavation in pancreas.

After removing the pyloric end of the stomach for cancer we close the end of the duodenum with two superimposed purse-string sutures and then apply the closed duodenal stump directly to the wound in the pancreas, as suggested by Willy Meyer.[4] The anterior peritoneum and adventitious sheath of the pancreas is then sutured to the anterior surface of the duodenum. We have used this method for something like six years and have not had leakage in a single instance either from the duodenum or the pancreas.

Fig. 2 shows the end of the duodenum closed by purse-string sutures and the vessels tied in the excavation in the pancreas. Fig. 3 shows the end of the duodenum fastened in the wound in the pancreas.

Ulcers of the posterior wall of the stomach often perforate and become attached to the pancreas. In a previous paper I described a method of transgastric excision of such ulcers.[5] These ulcers usually form an excavation into the body of the pancreas and it is necessary to excise them cleanly well down into the pancreatic tissue, leaving no area of infection. This opening cannot be closed by sutures and after stopping the hemorrhage with catgut on a needle, a piece of the gastrohepatic or gastrocolic omentum is mobilized and turned into the excavation in the body of the pancreas, being held in place by catgut sutures. In our earlier cases we used a drain of folded rubber tissue but abandoned it as unnecessary since no drainage followed.

II. INJURIES TO THE PANCREAS IN THE COURSE OF OPERATIONS ON THE SPLEEN.

In 31 splenectomies performed in our clinic the tail of the pancreas was injured three times, owing to the fact that the tail passes with the splenic vessels well up into the hilum of the spleen. In performing splenectomy the spleen is withdrawn from the abdomen, the adhesions to the diaphragm and region of the left kidney are separated and a rubber-covered clamp of the Lower variety is used to catch the entire pedicle. The tail of the pancreas is often so closely

incorporated with the pedicle of the spleen that it occasionally is injured. This occurred in three of our cases.

In one case about one and one-half inches of the tail of the pancreas was found attached to the removed spleen and the pancreatic duct was plainly visible in the ligated stump. After covering the stump with peritoneal tissue and attaching a drain (which was unnecessary since no drainage followed) it was allowed to drop back into position. The patient recovered.

In the second case the tail of the pancreas was found tied in the pedicle about an inch from the tip. Since the case was one of splenic anæmia and the patient in poor condition, the stump was allowed to drop back in this condition. The patient recovered. The third case (A77736) was a male, aged twenty-six years, in whom a diagnosis of splenic anæmia had been made. At operation (January 14, 1913), the spleen was found to be of great size, extending well to the right of the median line and down to the brim of the pelvis. On account of the adhesions it was unusually difficult to remove the spleen from the abdominal cavity. The clamp was applied and the organ cut away. Catgut ligatures were applied to the splenic pedicle in sections. As the ligatures were tightened on the splenic artery, which was large, tortuous and atheromatous, it cut through and, with a gush of blood, dropped down behind the pancreas. It was caught with the fingers and compressed against the body of the pancreas while a second ligature was applied. This cut through also and it was evident that the splenic vessels would not maintain direct ligature. A double catgut strand was therefore placed around the entire body of the pancreas about three inches from the tail including the splenic vessels, the pancreas being used to strengthen the walls of the vessels. The pancreatic tissues were considerably crushed as the ligature was pulled taut. The hemorrhage was controlled immediately but as softening of the pancreatic tissue with loosening of the ligature was feared, a second ligature was applied in the same manner but one inch further to the right. It is probable that complete separation of four inches of the pancreas from the head and remainder of the body occurred. The patient made a good recovery and left the hospital in two weeks.

Coffey [6] demonstrated experimentally that tying the pancreatic duct with or without the surrounding pancreatic tissue

would not permanently occlude the pancreatic duct, that the duct would regenerate and reunite within a few days. While the duct itself was not actually tied, the pressure of the ligatures about the pancreas must have been sufficient to mechanically obstruct its lumen. The abundant supply of blood from numerous sources prevented serious damage to the nutrition of the portion of pancreas cut off by the pressure of the ligature.

III. RESECTION OF HALF THE PANCREAS FOR TUMOR.

CASE No. A68699.—J. L., female, aged thirty-seven years. Date of operation, June 15, 1912. History of severe attacks of pain extending into the left abdomen, and left lumbar region so severe at times as to necessitate the use of morphin. At no time was the patient free from pain. Point of tenderness over the region of the body of the pancreas. Loss of weight, 17 pounds. Duration of illness, 3 months. Contents of stomach, stools, blood, and X-ray negative. Tentative diagnosis, cholelithiasis with pancreatic involvement. An exploratory incision was made two inches to the right of the median line in the upper rectus muscle. There were no gall-stones but a hard, irregular tumor the size of an egg was found in the body of the pancreas about its middle. A second working incision was made through the upper rectus muscle three inches to the left of the median line. The gastrocolic omentum was divided, the stomach drawn upward and the transverse colon downward. The body of the pancreas and the tumor were brought to the surface as well as possible. It seemed best to begin at the tail and remove the left half of the pancreas with the tumor. This proved to be a difficult procedure since the entire pancreas was deeply placed and fixed in position. One of the deep veins was injured and a free hemorrhage occurred which was difficult to control without injury to the splenic vessels. Finally the tail and body of the pancreas with the tumor, about 4½ inches in all, was separated, a strong clamp applied across the body one inch to the right of the tumor and the left half of the pancreas with the tumor cut away. Four clamps had previously been attached to vessels in the deep portions of the wound. An attempt was made to tie off one of these clamps with catgut on a needle, and a fresh point of bleeding which required another clamp was the

result. The handles of the five clamps and the handles of the clamp previously placed across the body of the pancreas were brought to the surface and the cavity from which the pancreas had been removed was packed loosely with gauze. On the fourth day the clamps were loosened and on the fifth day they were removed. The gauze was removed on the tenth day. The patient made a good recovery, regained her normal weight and remains well. The tumor, which had the external characteristics of a malignant growth, proved on section to be a benign thick-walled trabeculated cyst buried in sclerosed pancreatic tissue.

Resections of the pancreas for tumor have seldom been made, although as far back as 1884 Billroth[7] removed the pancreas for an adenocarcinoma with recovery of the patient. Finney[8] collected 16 cases from the literature in which the pancreas had been removed for tumor, and he reported a most interesting one of his own. There were 9 recoveries and 8 deaths in the series. All of the fatalities occurred in cases of resection for malignant disease. In Finney's case and in two others, a complete resection including the tumor was made and the divided ends of the pancreas resutured with recovery of the patients.

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PANCREATIC AND PERIPANCREATIC LYMPHANGITIS.*

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THE pathogenesis of the inflammations of the pancreas is a subject of not only academic interest, but of extreme importance in the therapy and prevention of these affections. Clinical observations and experimental work have made it sufficiently clear that the various phases of acute and chronic pancreatitis depend on no single factor or set of factors. The underlying causes may be summarized as circulatory disturbances, toxæmias, obstructions of the excretory duct or ducts, and bacterial infection. Any one or any combination of these agencies may result in more or less acute or chronic damage to the parenchyma of the pancreas with accompanying alterations of its stroma, vessels, and ducts.

From work already done it has been determined that infection and duct obstruction are the two most important causes of pancreatitis. In the majority of cases, moreover, pancreatitis is not a primary condition, but occurs secondarily to some other focus of disease within the abdomen. Cammidge (*Lancet,* June 3, 1911) states that in 414 cases of which he has notes the pancreatic condition was secondary to some morbid condition of the digestive tract in 211 (51 per cent.). In 37 per cent. it was associated with disease of the biliary apparatus, chiefly gall-stones. Robson has reported that he found the pancreas involved to a greater or less degree in 60 per cent. of the cases of common duct cholelithiasis. Kehr,

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Mayo, Moynihan, and many other surgeons of wide experience in abdominal work, agree that this association is a frequent one, even though the figures given by different men as to the percentage of incidence vary rather widely in accordance with the personal equation in the interpretation of the findings at operation. Even post-mortem statistics may be cited to show the extent to which pancreatic lesions are dependent upon disease of the biliary tract. In McGlinn's study of 8515 post-mortem examinations made at the Philadelphia General Hospital, the pancreas was found diseased in 382 instances (0.4 per cent.). When gall-stones were present (506 cases) the pancreas was diseased in 66 cases (11 per cent.). These lesions were of the more marked variety, including tumors and the outspoken forms of pancreatitis. The lesser grades of pancreatitis, noted at operation, are not noted in this series.

Our own experience coincides with that of others in this respect and in addition we have been impressed by cases in which a similar relation appeared to exist in conjunction with diseases of the pylorus, the duodenum, and the appendix.

The following case is one of several that exemplify the association of pancreatitis with chronic duodenal ulcer:

CASE I.—J. W., aged sixty years, a farmer by occupation, was admitted to the German Hospital, April 23, 1913.

Chief complaint, dull pains in the epigastrium and nausea.

Present Illness.—Has been suffering from "dyspepsia" for past thirty years—pains in the epigastrium about the middle of the afternoon, relieved by the evening meal, pain again near midnight, again relieved by food. Has been troubled by belching and water brash. Baking soda relieved immediately. Has had periods of months when he was free from all symptoms. Ten years ago had an unusually severe attack lasting ten weeks, with nausea and vomiting, and severe epigastric pain three to four hours after eating. After this attack he felt better than ever before for the next four years. The past two months following an attack of "La Grippe" his condition has grown worse. He has vomited for the past week, at first several hours after eating, with relief of pain, and later immediately on taking food. The pain is referred to back. He vomited a little blood several times,

from straining, he thinks. He has lost 20 pounds in the last year. Feels strong.

Family and social history, negative. Had typhoid fever at ten years of age.

Physical Examination.—Anæmic looking old man. Poor musculature. Sclerotic arteries.

Chest: Negative.

Abdomen: Slight fulness in the epigastrium and lower abdomen. One tender spot in the epigastrium about two inches above the umbilicus, in the midline. No tender spot in back. Left inguinal hernia.

Blood pressure: Systolic, 164; diastolic, 110.

Laboratory Findings.—Blood count: Hæmoglobin, 69; red blood corpuscles, 4,580,000; white blood corpuscles, 8700; polymorphonuclear neutrophiles, 65; lymphocytes, 25; large mononuclears, 10.

Test breakfast: Quantity, 210 c.c., 800 recovered; occult blood, strongly positive to benzidine, faintly positive to guaiac; free HCl, 57; total acidity, 85.

Microscopy: Much undigested and partially digested starch. Much free fat. Epithelium.

Full meal (removed after 7 hours): Quantity, 75 c.c.; occult blood, positive to benzidine and guaiac; free HCl, negative; total acidity, 18; lactic acid, negative.

Microscopy: A little free fat; much undigested starch; epithelium.

Stool: Bile, faintly positive; occult blood strongly positive to benzidine; negative to guaiac.

Microscopy: Some free fat globules; vegetable fibres and granular debris.

Fluoroscope with bismuth (80 grammes).

Stomach neither dilated nor ptosed. Lower border is high midway between umbilicus and ensiform. Very poor peristalsis.

Operation (April 28, 1913).—Upper right rectus incision. The second portion of the duodenum is the site of a healed ulcer. The head of the pancreas is enlarged and compresses the duodenum. It shows the appearance of chronic inflammation and does not suggest malignancy. The peripancreatic tissues are thickened and the regional lymph glands are enlarged. The duodenum was plicated over the site of the ulcer and a posterior gastro-enterostomy performed.

Fitz laid stress upon chronic duodenitis as a factor in the production of pancreatitis. Alcohol, which is of some importance as a predisposing factor, probably exerts its influence through the production of gastroduodenal catarrh.

Robson reported that among 46 cases of interstitial pancreatitis with gall-stones or other removable cause there were five where the pancreatitis was associated with duodenal ulcer.

We have previously pointed out that pancreatitis is more common in men than in women, the reverse of what is true in biliary disease. This fact casts doubt upon the origin of pancreatitis through the medium of infection from the biliary tract, but readily parallels the greater frequency of gastroduodenal catarrh in males. We have observed that the duodenal ulcer when it is situated at its usual point of predilection, just distal to the pyloric ring, is less apt to be complicated by pancreatic involvement than when the ulceration is in the second portion of the duodenum in closer relationship to the pancreas. We are not speaking now of the cases of chronic perforation of the duodenum by which the ulcer eventually comes to make its bed in the tissues of the pancreas, but of those cases of non-perforating ulcer in which the route of transference of the infection to the pancreas is not so obvious.

In what manner does the pancreas become involved secondarily to infection of other portions of the digestive tract? During the past year and a half we have been noting this condition of the pancreas and its surroundings particularly with this question in mind. We have observed a large number of cases of pancreatic involvement prior to this date, but as our interest in the particular variety of etiology with which this paper deals began about that time we have considered only the more recent cases. The relationship of the appendix to pancreatitis we have not had the opportunity to investigate, not feeling justified in making an upper abdominal exploration during the course of an appendectomy.

During this time the pancreas has been investigated in the following cases and found involved or uninvolved, as indicated in the following table:

	No. of cases.	Pancreatitis present.	Pancreatitis absent.
Cholelithiasis	99	40 (40.4 per cent.)	59 (58.6 per cent.)
Cholecystitis	14	9 (64.2 per cent.)	5 (35.7 per cent.)
Duodenal ulcer	16	2 (12.5 per cent.)	14 (87.5 per cent.)
Gastric ulcer	3	1 (33.3 per cent.)	2 (66.6 per cent.)

These groups are not sufficiently large to base a fixed estimate of the percentage liability of pancreas implication in the diseases mentioned, but they do show a striking frequency of involvement.

The avenues by which infection may reach the pancreas are: (1) The blood stream; (2) through the ducts, and (3) by way of the lymphatics.

The systemic circulation is but little considered in connection with pancreatic disease. The diseased conditions with which pancreatitis is associated are not characterized by bacteræmia, nor is the pancreas often affected in other conditions in which bacteria are commonly present in the blood stream. That this mode of infection may occur is evidenced by the participation of the pancreas in miliary tuberculosis, in syphilis, and occasionally by abscess formation in pyæmia. Still the weight of clinical evidence is against this source of infection of the pancreas in any considerable proportion of cases.

The ducts of the pancreas are commonly regarded as the vulnerable point in the gland's defences. They empty upon a mucous surface which is subject to inflammations and over which pass great numbers of pathogenic bacteria. Ascending infection under these conditions is a ready and seemingly satisfactory explanation of pancreatic inflammation. Furthermore, the usual mode of termination of the duct of Wirsung in the ampulla of Vater affords opportunity for the bile to gain entrance into the pancreatic duct. Gall-stones often travel down the common duct inducing inflammation as they pass and at times diverting the bile into the pancreatic duct in the manner pointed out by Opie. The bile is irritant in itself to the pancreas, and in addition it is frequently infected. Clinical and experimental proof is not lacking that this does

occur in life and that it may be productive of the most fulminating hemorrhagic necrosis of the gland. We may infer that the lesser and chronic types of inflammation also may result.

It is not the intention of this paper to deny the importance of this mode of infection, but rather to ask if it has not been overworked as an explanation of the swellings and indurations we are noting so commonly in connection with other abdominal inflammations, particularly in disease of the biliary tract.

The profession at present apparently has resolved the etiology of pancreatitis in connection with biliary disease into the simple picture of infection sailing down the common bile duct and up the duct of Wirsung. The walls of the vessels receive no attention. Yet it is in the walls of the gall-bladder and ducts that the infection chiefly lurks. It is not at all uncommon to find a culture of the bile negative when pronounced infection is evident in the tissues of the gall-bladder and ducts.

Of the 49 cases, in this series, investigated in the pathological laboratory of the German Hospital, the result of the cultures of the bile is as follows:

Bacillus coli	16
Bacillus typhosus	2
Sterile	24
Not culture	7
	49

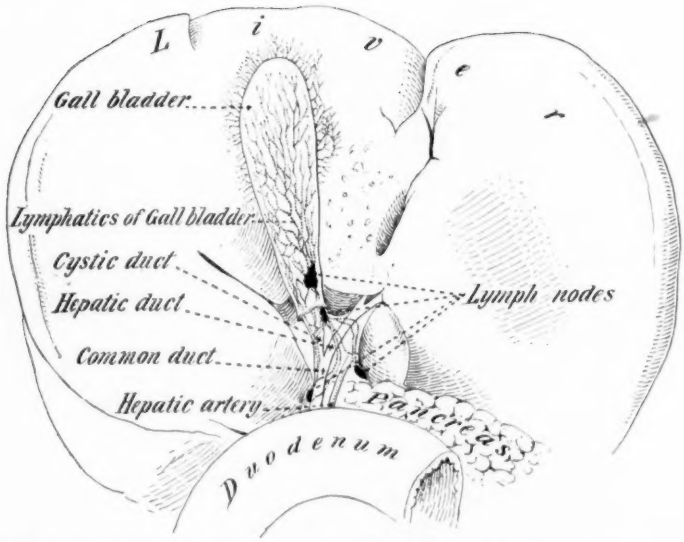
In acute infections of the biliary passages the surrounding tissues are greatly inflamed. Any organ in close relationship must be endangered by the proximity.

These swellings and enlargements of the pancreas, as noted by the surgeon, certainly differ from those states in which an overgrowth of the interlobular or interacinar fibrous tissue has taken place. There can be no rapid or material retrogression of the process which has progressed to a fibrous sclerosis. On the other hand it is characteristic of many of the swellings of the pancreas, as seen at operation, to subside more or less rapidly

FIG. 1.

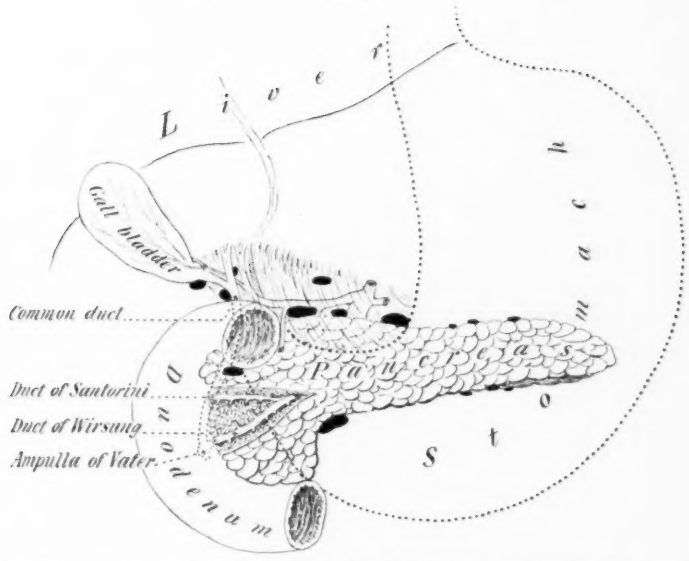
Duodenum and pancreas of newly-born dog, injected to show lymphatics. In many places an intimate connection exists between the pancreatic and duodenal lymph systems. After Bartels.)

FIG. 2.



Lymphatics of the gall-bladder. The duodenum is turned downward. The lymphatic trunks are represented by dotted lines which may be seen disappearing behind the posterior surface of the pancreas, to the surface of which they are intimately related. (After Franke.)

FIG. 3.



Black areas represent enlarged peripancreatic lymph-nodes commonly encountered in pancreatic lymphangitis.

and completely. This has been determined by secondary operations on patients who showed pancreatic swelling at the first operation, but none when the abdomen was reopened. Clearly the enlargement must have been due to engorgement and œdema or absorbable cellular exudates. It is only by accident that one could have the opportunity to secure for pathological examination a pancreas in this stage. Such an opportunity we have not had. Robson, however, speaks of such a case in which he operated for gall-stones, death occurring from apoplexy during the anæsthesia. A post-mortem examination of the pancreatic tissue surrounding the common duct revealed nothing abnormal to the naked eye, but a careful microscopic examination showed a small celled infiltration between the lobules of the pancreas and swelling of the secretory cells of the gland (*Surg., Gyn. and Obstet.*, January, 1908).

Such minor changes as these in the ordinary length of time which elapses between the death of a patient and the post-mortem examination would be obscured by the rapid autodigestion which the organ undergoes and therefore has been overlooked. The condition has therefore received no attention or name from the pathologists.

A fact which is difficult to explain on the theory that such swellings result from duct borne infection is the usual localization of the lesion in the head of the organ, the tail, as a rule, being unaffected so far as can be determined by palpation. In the cases observed during the past one and a half years the head was affected alone in 42 cases, and in only 9 was the tail of the organ noted as showing any alteration in shape, size, or consistency. In 27 cases there was well-marked lymphadenitis of the glands in the peripancreatic tissue. It is not the rule in other glands, supplied by ducts which divide dichotomously, for ascending inflammation to be limited to the area adjacent to the terminations of the ducts. Thus, in cholangitis the fine radicles at the periphery of the liver show equal involvement with those near the portal fissure. In the pancreas itself the late lesions observed pathologically show sclerosis as marked in the tail as in the body and head. The so-called triangle of

pancreatic inflammation lying between the duodenum and the converging ducts of Wirsung and Santorini should not be so commonly affected to the exclusion of the remainder of the pancreas were the infection carried by the ducts, since the remainder of the pancreatic tissue is just as truly supplied by and dependent on these ducts as are the tissues of the triangle. In our opinion a more significant relation is to be found in the proximity of the common duct in its retroduodenal and pancreatic course to this portion of the head of the pancreas.

A path of infection to the head of the pancreas which has received too little attention is that by way of the lymphatics. In the excellent work of Robson and Cammidge on the pancreas, four lines are given to the anatomy of the lymphatics of the gland. In all the extensive literature on pancreatitis it is only rarely that the lymphatics are mentioned. Considering the importance of the lymph channels in both the transmission of infection and in recovery therefrom this neglect is unjustifiable. The pancreas is well supplied with lymph vessels which run in the interlobular septa in company with the blood-vessels and ducts. Unlike the majority of glands, however, the pancreas possesses no great hilum through which emerge the blood and lymph vessels united into trunks of supply. The lymphatics emerge at various points along the course of the gland and make their way through the retroperitoneal cellular tissue to join the thoracic duct. In this retroperitoneal tissue they anastomose with lymph trunks coming from the stomach, duodenum, spleen, liver, gall-bladder, and bile ducts, the colon and even the left suprarenal. Probably still other intercommunications exist which have not yet been demonstrated. Bartels has shown that a particular intimacy exists between the lymphatics from the duodenum and the head of the pancreas.

Through the duodenal lymphatics he has injected vessels which are directly applied to the surface of the pancreas. These vessels inosculate with those coming from the head of the pancreas, and, while he did not succeed in injecting the intrinsic pancreatic lymphatics from the duodenum owing to the competency of the valves, he stated that under pathological condi-

tions the valves would not be likely to prove such an efficient barrier.

Franke has shown that a similar close relationship exists between the lymphatics of the gall-bladder and the head of the pancreas, and Arnsperger has argued the clinical force of such a relationship.

That gall-bladder and duodenal inflammations do cause marked peripancreatic lymphangitis is very easily made out. We have seen scores of such cases since we began to recognize the condition. In a fortunate case the march of the infection is easily demonstrated: inflamed gall-bladder, enlargement of the cystic lymph-glands, periductal lymphangitis, enlargement of the glands at the head and margin of the pancreas and often swelling of the regional lymphatic distribution of the head of the pancreas. In such a case it is not easy to resist the conclusion that the pancreas in this portion had become affected through the lymphatics rather than to assume that the infection had circumnavigated the ducts and localized itself in the pancreatic head.

The irregularly segmental distribution of the lymphatics of the pancreas harmonizes well with the localized areas of infection observed clinically. The lymphatics given off from the common duct in its pancreatic portion in the presence of a marked infection with much periductal swelling and infiltration could hardly fail of being communicated to some extent to the neighboring pancreatic tissue, unprotected as it is by a dense and avascular fibrous capsule.

To the objection that infection, to be carried into the pancreas, must stem the efferent lymph current and force the valves, the answer can be made that everyone has seen infection in cellular tissues proceed in a reverse direction to the lymph-current. Thrombolymphangitis readily diverts the normal lymph course and infection easily destroys valves. The forces of pathology here as in so many other instances pervert the normal function.

The pre-operative recognition of pancreatic lymphangitis in the majority of cases is not yet possible. The greater part

of the pancreas remains unaffected and is able to furnish both internal and external secretions to supply all bodily needs. The local signs of inflammation, such as pain and tenderness, are not sufficiently distinctive to be separated from gall-bladder or duct inflammation or from duodenal disease. Occasionally it is possible to palpate the enlarged pancreatic head, but as a rule this cannot be done.

Cammidge's specific reaction "C" has not been of assistance to me. In the laboratory of the German Hospital we have carried out this reaction in upward of 700 cases and have found that it cannot be relied upon as indicating the presence or absence of pancreatic involvement. A Cammidge test was made in 10 of the cases in this series with positive result in 6 instances, negative in 4.

We may infer with fair certainty that the pancreas is affected in the more severe cases of long standing, particularly when the symptoms point to common duct involvement, with tenderness in the median line over the head of the pancreas. But we have failed to find pancreatic swelling in such cases, while in others of very recent origin it has been present.

Under this conception the problem of treating these inflammations resolves itself into the appropriate treatment for the primary infecting focus. The pancreatic and peripancreatic inflammations are analogous to cervical adenitis, secondary to tonsillitis or to inguinal adenitis following upon an infection of the extremity. The subsidence of infection in the gall-bladder, whether brought about by medical or by surgical means, is speedily followed by disappearance of the lymphangitis dependent upon it. In view of the fact that medical treatment, while at times successful, is notoriously slow and prone to fail, and in any case less likely to guard against recurrence it must be regarded as attended by more serious risk of permanent damage to the pancreas.

If the early stages and milder degrees of involvement of the lymphatics of the pancreas may produce but little disturbance and disappear upon subsidence of the primary infecting focus, it is also true that any long continued lymph stasis and infil-

trations with damage of the tissue elements must lead to deterioration of the parenchyma and the deposit of fibrous tissue. Swelling of any portion of the pancreas to a greater or less extent causes obstruction of the ducts in that region, so that in this instance also we have the obstructive element added to that of infection.

In the more acute processes suppuration may ensue. Abscesses are most likely to be found in the head of the pancreas. An example of this condition is the following case operated upon in the University Hospital:

CASE II.—I. P., female, aged fifty-two years; admitted February 23, 1913.

Chief complaint, severe pain in right side of abdomen, nausea, and vomiting.

Past medical history, had typhoid fever when very small, otherwise no serious illness, but says she has never been strong.

Family and social history have no bearing.

Present Illness.—For the last seven years she has been having "stomach trouble," eructations of gas, heart-burn. Six days before admission she was seized with severe pain in the right upper quadrant of the abdomen, which radiated to the left scapula. Has never vomited blood; has been habitually constipated, and at times noticed the stools were light in color. She never noticed any jaundice prior to this attack.

On admission, temperature, 98.6; pulse, 92; respiration, 20. She was well-nourished and of rather healthy appearance, though somewhat pale. Scleræ showed a slight tinge of jaundice.

Chest: Negative throughout.

Abdomen: Marked tenderness in epigastrium and right hypochondrium, with some rigidity and spasm on palpation. No masses felt.

Blood: Red blood corpuscles, 5,600,000; white blood corpuscles, 16,800; hæmoglobin, 85. Differential: Polymorphonuclear, 92 per cent.; lymphocytes, 5; transitional, 2; eosin, 1.

Gastric analysis: Free HCl, 20; total acidity, 40; occult blood, positive. Fæces showed no bile and were otherwise negative.

Operation (February 28, 1913).—The gall-bladder was found filled with stones. It was acutely inflamed and very friable. The tissues around the common duct were swollen but the duct

itself did not appear to be dilated. There was much enlargement of the lymph nodes in the gastrohepatic omentum. The cystic gland was greatly enlarged; the head of the pancreas was swollen to the size of a man's fist with much peripancreatic infiltration; the tail appeared normal to palpation. The stones in the gall-bladder were removed and drainage instituted by a dressed tube. The common duct was opened and explored, no stones were present and the probe passed without difficulty into the duodenum.

The patient's condition was satisfactory after the operation, but during the following week she exhibited a septic temperature with attacks of dyspnœa and palpitation, during one of which she died, March 8, 1913.

Only a partial postmortem was obtainable. The head of the pancreas was greatly swollen and contained several small interstitial abscesses. About the head of the pancreas there was also some suppuration in the peripancreatic tissues. The tail of the organ was slightly enlarged and on section showed a few flakes of fat necrosis.

Microscopic examination showed in the head of the pancreas chronic interlobular and interacinar pancreatitis with acute suppurative process implanted upon it, the tail showed also chronic pancreatitis, but to a much less marked degree. The acute changes also were distinctly less marked in the tail than in the head.

Reasoning from the pathological appearance we can believe that the head of the pancreas had been the seat of many previous attacks of inflammation. This portion of the organ had borne the brunt of the infection transmitted to it from time to time from the diseased gall-bladder. The history of the final attack together with the appearance of the gall-bladder indicated that the origin of the infection in this instance also was the gall-bladder and the lesser lesions, both acute and chronic, which were found in the tail can best be explained as secondary to the changes in the head of the pancreas.

It is not beyond the range of probability that certain cases of hemorrhagic pancreatitis may be initiated by infection reaching the pancreas through the lymph channels. It is certain that not all hemorrhagic pancreatitis is produced by the lodgement of a gall-stone in the papilla of Vater causing retrojection of the bile into the pancreatic duct. A fair per-

centage of such cases are not accompanied by gall-stones. Neither is it necessary that duodenal contents be regurgitated into the pancreatic duct in order that activation of the retained pancreatic ferments may occur. The hormone secretion arriving by the blood stimulates the secretion of pancreatic juice. Activation of the juice within the gland is not necessary to its digestive action as the clinical observations of fat necrosis and the post-mortem autodigestion of the gland will attest. With infection of the gland, obstruction of the ducts by a resulting engorgement and stimulation of the active pancreatic secretion by hormone action we have all the conditions necessary for focal necrosis of the pancreas, erosion of the blood-vessels, diffused hemorrhage followed by extensive gangrene and suppuration.

If we entertain these ideas of the causation of pancreatitis we must be influenced in our methods of treatment of the lesions of the gall-bladder and the duodenum when pancreatitis is associated.

Theoretically prompt removal of the focus of infection is desirable. Cholecystectomy and excision of ulcer must therefore be viewed from this angle. We have always been opposed to cholecystectomy unless strong indications were present. There is not sufficient time to discuss the pros and cons of this question in which many other factors enter. At this present time, however, we favor the more radical treatment of an obviously thickened and sclerotic gall-bladder when pancreatic lymphangitis is associated with it. In other words we are less disposed to take chances on recurrence of inflammation in the gall-bladder in cases where the fate of the pancreas is also concerned. It must not be forgotten that cholecystectomy is an operation of slightly greater mortality than simple drainage of the gall-bladder and we must therefore strike a proper balance between the immediate and remote dangers. Cholecystostomy in many instances is curative in a surprising manner and must remain the operation of choice in the majority of cases. Cholecystenterostomy should be reserved for those cases in which more or less chronic obstruction of the common duct is a feature.

LARYNGECTOMY FOR CANCER.*

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THE legitimacy of operation upon any part of the body, especially those parts the damage of which may cause immediate danger to life, depends upon the answers which can be given to three vital questions: Will the operation result in the cure of the disease? Can the risks be overcome? What will be the extent of permanent disability? So uncertain until very recent years have been the answers to these questions as applied to laryngectomy for cancer, that it is not strange that the operation is one of the most recent developments in surgical history, having been first performed by Billroth in 1874.

Even after surgeons had become convinced of the possibility of the cure of intrinsic laryngeal cancer by this means it was, and is still, most difficult to persuade patients to submit to it—the instinctive objection to deep throat operations being the natural outcome of the experiences of the far distant past when the throat was the point of attack in our carnivorous evolutionary ancestors, and it being still the part most liable to danger in hand-to-hand conflict.

Does laryngectomy for cancer result in a cure of the disease? Upon our answer to this depends the need for considering the other two questions. We still accept Krishaber's classification of laryngeal cancer as intrinsic and extrinsic. As the term implies, intrinsic laryngeal cancer starts within the larynx itself in the vocal cords, the ventricular bands or the parts below; while the extrinsic form starts in the epiglottis, the arytenoids or other parts outside the larynx proper. Intrinsic cancer, then, is contained within a hyaline cartilage box and is practically cut off from the possibility of lymphatic involvements; while the extrinsic form grows

* Read before the American Surgical Association, May 7, 1913.

rapidly and can easily and early extend through the lymph channels.

Early diagnosis and removal is the keynote of safety in cancerous growths anywhere, and laryngeal cancer makes itself known almost at once, since from its very beginning the probability of its presence becomes evident in the persistent hoarse voice of the patient. We may say, then, that intrinsic laryngeal cancer exists, as it were, in a safe deposit box. It early announces its presence and has but feeble power of extensive invasion or of metastasis. We conclude, therefore, that this form of cancer of the larynx is curable by excision. Extrinsic cancer, on the other hand, is rapidly fatal, and operation for its relief is at best but a desperate remedy.

What is the surgical risk? I have myself performed twenty-seven laryngectomies for cancer with two operative fatalities; one death resulting from mediastinal abscess, the other from necrosis of the trachea with a consequent septic pneumonia. This makes a mortality rate of 7 plus per cent., a rate which compares favorably with that of the excisions for cancer of the tongue, of the stomach, and of the rectum.

What is the permanent disability of the patient? Those principally feared are impairment of speech, disfigurement, and a predisposition to pulmonary diseases and accidents. As to speech impairment, all patients acquire a buccal whisper which serves the purposes of speech remarkably well. One of my patients is at the head of a large industrial corporation; another is a judge; another is foreman in a public works department; another became a popular barber; still another is managing a small coal sales agency; one housewife apparently gets on well enough; and a farmer has managed his flocks and his teams in silence. The speech defect, to be sure, is great, but it can be compensated to a remarkable degree by the development of the buccal whisper, the use of gestures and other forms of primitive language, and by the adaptation of those individuals who come into daily contact with the patient.

The disfigurement may be well covered by wearing various

kinds of cravats or neckwear arranged in such a manner as to allow free breathing, and at the same time to diminish the sibilant sounds of the changing air currents.

As to the predisposition to accident and disease, to my knowledge there has been no instance of a foreign body in the respiratory tract of any of my laryngectomized patients, nor has there been a single case of pneumonia. Not only have my patients shown no tendency to pneumonia and bronchitis, but they have been remarkably free from nasal colds.

We may conclude, then, in answer to our third question, that though the disability resulting from laryngectomy is great, yet it is fairly well compensated.

Some years ago I made an interesting study of the laryngectomies reported in the medical press from 1873 to 1901. A summary of the statistics gives significant results. From 1873 to 1876, 12 laryngectomies for carcinoma were reported with one ultimate cure, making the percentage of ultimate cures 8.33. From 1876 to 1886, 108 laryngectomies, 21 ultimate cures, percentage of ultimate cures 19.44. From 1886 to 1896, 156 laryngectomies, 49 cures, percentage of cures 23.82; from 1896 to 1901, 30 laryngectomies, 20 cures, percentage of cures 66.67. The causes of death as reported are those with which we still are contending, but which improved technic has helped us in large measure to meet. Indeed, the figures just given show the increasing confidence of surgeons and patients in operative relief for this distressing disease, a confidence well supported by the rapidly decreasing mortality rate.

Before proceeding to a description of the general technic of the operation, let us consider how the special difficulties and dangers may be overcome.

1. *Pneumonia.*—Pneumonia following operation on the upper air passages is due in most instances to one of two causes: (*a*) The inhalation of blood, and (*b*) the inhalation of infected wound discharges. These injurious inhalations occur usually in the course of the operation, although occasionally the post-operative oozing is inhaled. They may be

prevented in part by scrupulously maintaining a dry field in the entire course of the dissection. This is accomplished by picking up every vessel that is large enough to be considered at all, either before dividing it or immediately after it has been divided. In this manner the field will be kept so clear of blood that all anatomical structures may be easily seen and identified. During the later stages of the dissection the vessels which have been picked up may be ligated with either light catgut or light silk. While this manner of dissection may at first seem to be tedious, it will in the end prove to be the quickest method, and is the method of choice in dissections for the exposure of the larynx, pharynx, trachea, or œsophagus. When the field of operation has been reached, however, the prevention of blood inhalation becomes a quite different problem, because the blood supply of the mucous membrane is maintained principally by terminal arterioles which cannot be effectively controlled by ligation. At this point in the operation one of two courses may be adopted. The patient may be placed in a head-down, inclined posture at such an angle that the blood will gravitate away from the lung; or by the hypodermic use of novocain and adrenalin the trachea, the larynx, and the pharynx may be entered without resultant coughing or material oozing. If the mucous membrane has been locally anæsthetized the bleeding may usually be controlled by the local application of pledgets of cotton pressed firmly against the bleeding points by hæmostat forceps. The further control of hemorrhage depends upon the circumstances of the individual operation. If conditions permit, a rubber tube which will snugly fill the trachea or even distend it will entirely control the dangerous factor of blood inhalation. This point will be considered later in connection with the administration of the anæsthetic.

There are both advantages and disadvantages to the control of hemorrhage by posture, for the amount of hemorrhage, especially of venous hemorrhage, is increased by gravity. Then, too, the head-down position is less favorable for the operator. The direct control method has the advan-

tage of light, accessible position and the minimum bleeding. In my experience I have rarely found it necessary to resort to the head-down posture, although it has been temporarily used, occasionally during some phase of an operation. Occasionally, of course, a great emergency may exist in which the head-down posture is urgently demanded.

2. *Local Infection.*—The next great danger associated with laryngectomy is that of local infection, for it occasionally happens that after the air passages have been opened a serious local infection will spread over the contiguous territory and along the deep planes of the neck. The occurrence of some infection must be taken for granted, but it is for us to consider by what means the amount and the virulence of the infection may be diminished and how it can be localized. In the first place, the danger may be minimized in advance by canvassing all of the contiguous territories and making sure that there are not present any active foci of infection, such as decayed teeth, pyorrhœa, alveolar abscesses, discharging sinuses, peritonsillar abscess, pharyngitis, or purulent rhinitis. At the time of the operation itself we may control the local severity of the infection by using only sharp dissections and by minimizing to the utmost the trauma of surrounding tissues; by leaving no oozing of blood; by making careful decisions as to the immediate closure of the soft parts overlying the wound, and by using iodoform packing if there must be any wound in the soft parts of the throat and neck. When infection has been inaugurated there are no better therapeutic measures than the hot pack and the inhalation of medicated or plain steam.

3. *Mediastinal Abscess.*—After pneumonia, mediastinitis and mediastinal abscess have been the most fatal after-results of laryngectomy. The onset of infection is usually a week or ten days after the operation, and is characterized by a steeple-chase temperature, not high, and always remitting in the morning. There is usually but little pain, and the course of the disease is toward slow, but certain death. In many respects it resembles the retroperitoneal abscesses which also

come late, are almost painless, progress slowly, show a steeple-chase, but low temperature curve, and end usually in death. The explanation of the characteristic, painless, tedious and fatal course of mediastinal abscess is probably found in the fact that this region of the body has always been protected from wounds by the bony chest wall. Being closed to wounds through the vast periods of man's evolution, it has been closed likewise to infection. The tissue of this protected region, therefore, has not been endowed with the elements required to efficiently meet and overcome infection as have been, for example, the peritoneum and the external parts of the body. In view of this fact, we must guard this helpless territory with special care. How can this be done?

As we have shown that pre-operative measures may in large degree prevent the extensive course of local infection, so the danger of mediastinitis may be guarded against by pre-operative protection. If in the course of the laryngectomy the divided trachea is stitched to the skin, there is great danger that subsequent coughing will cause it to become detached. Its moorings having been lost, it will be thrust back and forth, in and out of the thoracic box, like the piston of an engine. Mediastinal infection will be the almost inevitable result. If, on the other hand, the free end of the trachea is not fixed by sutures, but is held by gauze packing about it, then the trachea will retract within the thoracic cage like the head of a turtle, and again infection must result. It is obvious, then, that the trachea should be so fixed by preliminary operation that there may be produced an invincible barrier of granulations extending across the base of the neck and the entrance to the thoracic cage. There are two methods by which this may be done: The ordinary simple tracheotomy will fix the trachea and will stimulate the formation of efficient granulation tissue; or exposing the trachea and the lower larynx and packing the lateral planes of the neck with iodoform gauze will result in the production of granulations and in fixing the trachea so firmly that coughing cannot break its moorings. Each of these methods by itself alone has certain

advantages and disadvantages. The simple tracheotomy is not so certain a safeguard against infection of the mediastinum as is the latter, and it does not result in so firm a fixation of the trachea in the deeper part of the neck; but it has the advantage of establishing a strong defense mechanism in the mucous membrane of the trachea itself. On the other hand, the packing of the deep planes with iodoform, while otherwise an ideal protection, does not supply the protective defenses in the mucous membrane of the trachea. An ideal defense, then, is found in a combination of the two operations, that is, in opening and packing the deep planes of the base of the neck, and at the same seance making a low tracheotomy. By this means the mediastinum is put under strong guard, and at the same time the later technic of the laryngectomy is measurably reduced.

4. *Vagitis.*—Though a less frequent risk than those we have described, vagitis represents a formidable and special danger. In the course of the convalescence following laryngectomy, usually after the fourth day, a group of new symptoms is occasionally introduced; the pulse becomes very rapid and irregular in rate and rhythm—it may jump from 90 to 140 in a few minutes; the heart's action becomes tumultuous at times; the patient is quiet or perhaps a little apprehensive. Death from vagitis has been reported, though in my own cases the symptoms passed after a rather boisterous course of a few days. It is probable that the trunks of the vagi have become involved in the wound infection and as a result these nerves have been rendered unfit to properly conduct stimuli. Hence there arises the striking conflict between the vagus and the accelerator control, the picture being very similar to the immediate effect of crushing or dividing both vagi simultaneously. As a protection against this, one might utilize the well-known physiologic fact that the division of one vagus causes no notable change in the heart's action. In the course of extensive dissections for the wide excision of cancer of the neck I have eight times excised a portion of the trunk of one vagus. Close observation of the pulse and respiration de-

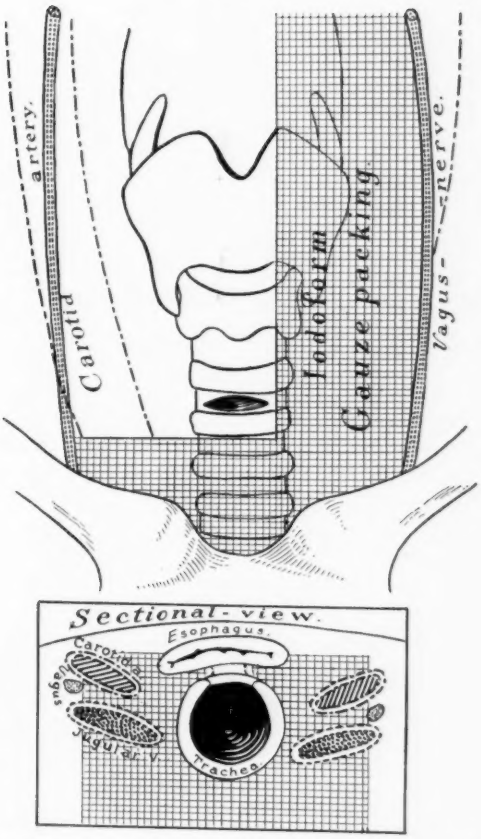
tected no change nor was any later alteration observed. Following this indication, then, at the preliminary operation one should carry the dissection on one side of the larynx all the way to the upper margin of the field of final operation, and should pack this territory with iodoform gauze just as the deep planes of the neck are packed. By this procedure one vagus must take the brunt of exposure and adjustment before the larynx is removed. By the time the laryngectomy is done this vagus would be readjusted and ready to resume its function in case it was affected at all, and so the heavy onslaught of the vagi upon the heart would not be made by both vagi simultaneously. In the case in which I tried this plan it seemed to be completely effective. When vagitis has become established there is little that can be done to alleviate it, although hot applications are apparently of some service.

5. *Reflex Inhibition of the Heart and Respiration through Mechanical Stimulation of the Superior Laryngeal Nerves.*— This is a minor phenomenon peculiar to the surgery of this region, but it is reported to have resulted in several deaths and has caused much anxiety and trouble to those who have never known of its existence and who have not known how to interpret and obviate it. The terminals of the superior laryngeal nerves in the larynx and on the surface of the rima glottidis are of necessity disturbed, and the trunks of these nerves are divided in the course of operation. The function of the laryngeal nerves is the protection of the pulmonary tract from the entrance of foreign bodies. The slightest touch of their endings, therefore, causes a cough reflex, and a strong contact will cause an inhibition of respiration and of the heart. The nerve supply of the trachea has no such function, but the area of distribution of the inhibitory nerve endings extends over a part of the pharynx and a part of the posterior nares even. Fortunately, we have an absolute protection against this dramatic and sometimes dangerous phenomenon, in the hypodermic administration of $\frac{1}{100}$ grain atropin (adult dose) before the operation. In addition a spray, a local application, or the local hypodermic injection of novocain will control absolutely the inhibitory reflexes.

6. The last special difficulty which we shall consider relates to the after care of the patient, and refers to the selection and care of the tracheal canula. After trying many kinds of canula, I have found that the common male or female curved canula or plain rubber tubing even, will answer all purposes. The greatest care should be exercised in adjusting the metal tubes so as to prevent a decubitus on the posterior wall of the trachea. Rubber tubing is preferred by some patients, but the metal tubes usually are best. A rubber tube drawn over a metal tube is perhaps the easiest to wear, but I have found that patients become careless with their familiarity with danger, and will wear loose-fitting tubes. This point was strongly impressed on my mind by the difficulty I once encountered in extracting a rubber tube that had slipped off the metal tube and had been carried deep into the trachea. After a stormy session in which the patient almost suffocated, the tube was caught by groping deep within the trachea with a curved hæmostat forceps and it was extracted while the patient was unconscious from asphyxia. In time all laryngectomy cases get along without tubes. In fact, in my recent cases I have been able to dispense altogether with tracheal tubes, both at the time of the operation and ever afterward, and my patients have all preferred to get along without phonating apparatus.

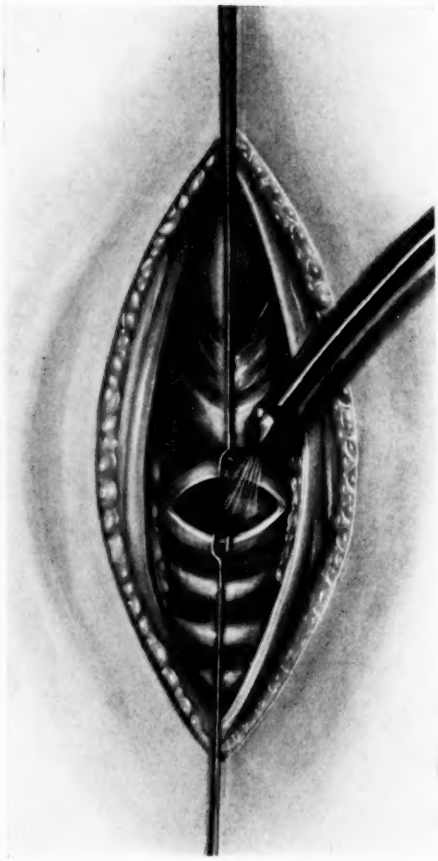
Anæsthetic.—Before proceeding to the detailed technic of the operation itself, some special statement should be made regarding the manner of administering the anæsthetic. It should be borne in mind that the administration of the anæsthetic should be so planned that the operator may be unhampered in his technic, that the anæsthetist may give an even and safe anæsthetic, and that there may be no inhalation of blood, while the choice of the anæsthetic itself is a most important factor. Our general anæsthetic of choice is nitrous oxide. The patient already—it is to be presumed—in fear of the possible suffocating results of a laryngeal operation, takes this anæsthetic without the terrifying suffocating symptoms caused by ether, and is quickly under its influence without a struggle.

FIG. 1.



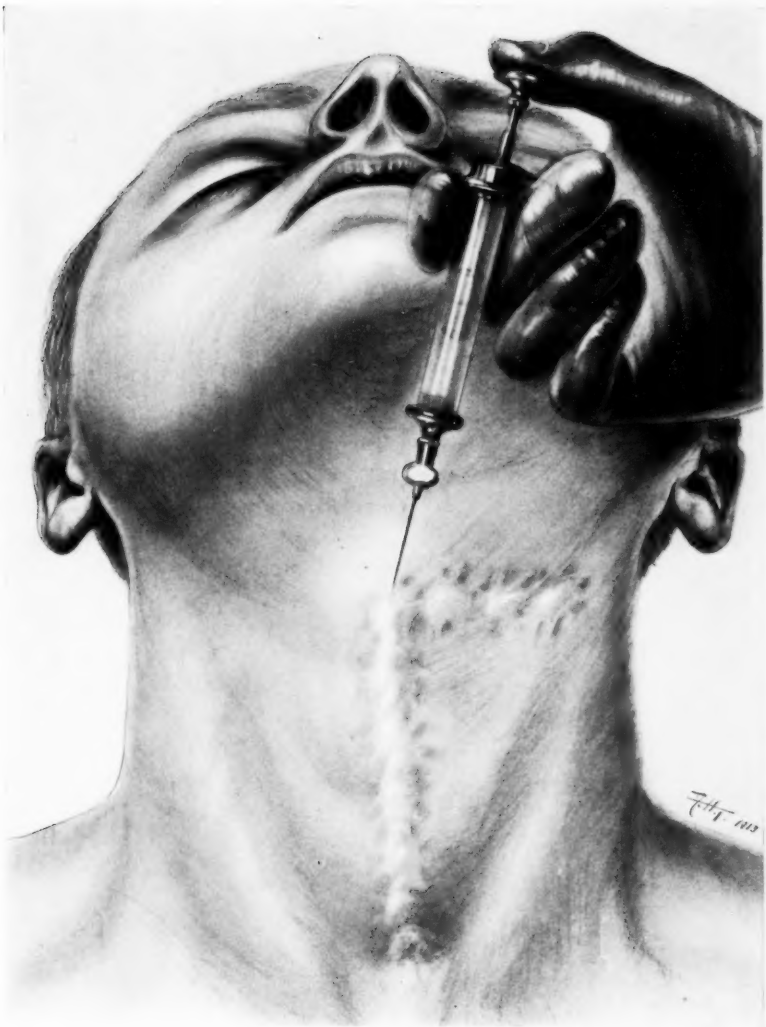
Schematic drawing to illustrate the method of packing the lateral planes of neck with iodoform gauze at preliminary operation.

FIG. 2.



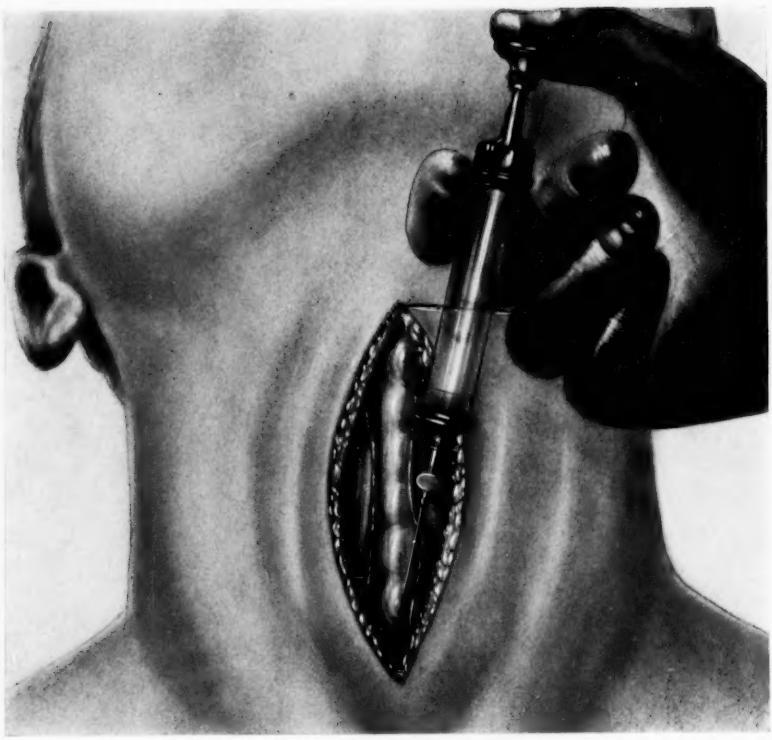
Novocainizing the superior laryngeal nerve endings of the trachea.

FIG. 3.



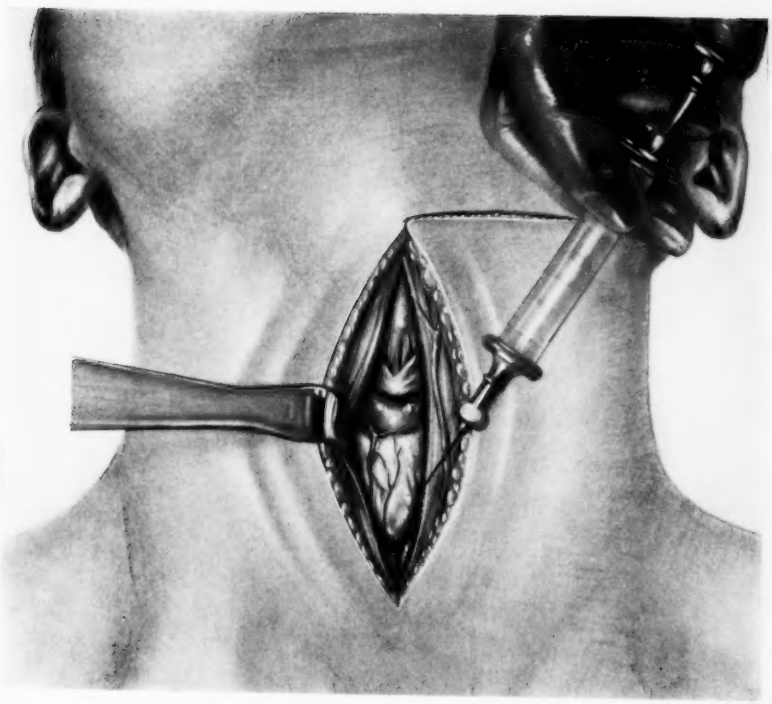
Infiltration of skin with novocain.

FIG. 4.



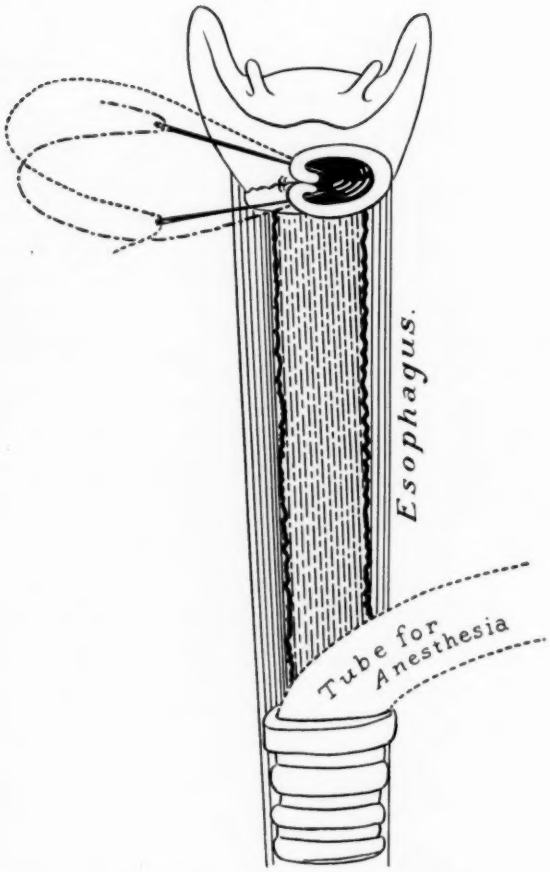
Infiltration of fascia with novocain.

FIG. 5.



Infiltration of the deep tissues of the neck with novocain.

FIG. 6.



Shoemaker's stitch used in closing pharyngeal opening.

We have proved also by laboratory experimentations that nitrous oxide hinders the general impairment of the patient, whereas ether is often an adjuvant to such impairment. Since nitrous oxide, however, should be given by the trained anæsthetist only, the following technic is equally applicable to the administration of ether. We have described already the preliminary tracheotomy by means of which the trachea has become firmly fixed in its position. At the time of operation the tracheotomy tube is removed and a well-lubricated, snug-fitting rubber tubing a foot or more long is slowly and carefully slipped into the trachea. The rubber tubing being slightly larger than the trachea, the latter is dilated and the rubber tube compressed, so that a fluid-tight fit results. By this means the entrance of any blood into the respiratory tract is prevented. The long piece of rubber tubing may then be attached to the oxygen apparatus, or it may be joined to a special apparatus consisting of a funnel covered with gauze upon which ether may be dropped. By this arrangement the anæsthetist is at a distance from the field of operation and is unhampered by the operator, while the operator on his side is unhampered by the anæsthetist. There results an even anæsthesia and the best opportunity for a well controlled operation.

To prevent nocuous impulses from the field of operation from reaching the brain, and as a protection against the excitation of special reflexes through the mechanical stimulation of the trunk or terminals of the superior laryngeal nerves, novocain is used as a local anæsthetic. The manner of its administration will be given in the description of the technic of the operation.

Operative Technic.—First the skin is thoroughly infiltrated with novocain along the median line from a point above the hyoid bone to the tracheotomy opening. The tissues are divided down to the box of the larynx, the divisions of the platysma and of the other soft parts being preceded also by novocain infiltration. The dissection is then carried down along the lateral aspects of the larynx until the larynx is

completely freed. If there is lack of free working space at the upper end a lateral incision is made parallel with the hyoid. The thyrohyoid muscles above and the sternothyroid muscles below are severed. So far as its muscular attachments are concerned, the larynx is now completely mobilized. If the laryngoscopic examination has fixed accurately the limits of the neoplasm, the level of the division of the larynx may be predetermined, and the next step will be the division of the trachea or the cricoid at a level free from disease. Before this last division is made, however, novocain is infiltrated into the mucosa throughout the entire length of the proposed division. By this means the terminals of the superior laryngeal nerves are completely blocked and the mucosa may be divided and the larynx opened without causing a change in the respiration or the circulation. If the patient is old and the cartilage is ossified, it is necessary to exert the greatest precaution in dividing the larynx in order that the œsophagus may not be injured. The divided end of the larynx is next raised up and the attachment between the larynx and the œsophagus is divided with knife or scissors. In a short, thick neck the wings of the larynx which extend down laterally to protect each side of the œsophagus, are divided with scissors. The dissection is then carried upward until the upper end of the larynx is reached, where its posterior wall becomes fused with the anterior wall of the pharynx. The upper end of the larynx is then cut free, the larger arteries being severed at the very last. Hæmostasis must be most thoroughly observed throughout the operation. If the cancer is intrinsic the lymphatic glands which drain the diseased zone should be carefully removed with the larynx itself.

Two important questions now arise regarding the manner of dealing with the wound: (1) What shall be done with the end of the trachea, and (2) shall the entire wound of the neck be closed? As to the trachea, there are two alternatives, viz.: It may be freed sufficiently to bring it forward and stitch it to the skin, or it may be left where it lies, excepting at its very upper end, which may be bent forward and sewed

to flaps of skin brought down from each side. The advantage of the first method is that by this means the trachea is protected from the inhalation of wound secretion. The disadvantage is the very definite possibility that the loss of blood supply may result in gangrene of the trachea. This did occur in one of my cases. The objection to leaving the trachea in its natural bed and transplanting to it the skin flaps is the fact that wound secretion will almost certainly enter it. By giving the wound adequate care, however, this danger may be avoided.

As to the care of the rest of the wound, my best procedure has been to suture the opening in the pharynx and, if possible, to re-enforce this suture by drawing other soft parts together over it. The rest of the field is left open, being packed lightly with iodoform gauze. With such a wide open wound the secretions may be easily controlled and prevented from entering the trachea. The patient should be sustained by the fullest diet he can be made to take, and by most careful nursing. The sutures in the pharynx may not hold, but the formidable-looking wound will close very readily by granulation and contraction.

Laryngectomy is followed usually by a brisk local reaction; but since the mediastinum has been protected by the previous gauze packing, and the bronchopulmonary tract has been given a special defense by the preliminary tracheotomy, the patient is well equipped to meet the new condition.

Clinical Observations.—In my twenty-seven laryngectomies there were two deaths, and these two were apparently the most promising cases of all. The prognosis in these cases seemed so favorable that I ventured to discard the full preliminary preparations. In one case I made no preliminary protective operation of any kind, and the patient died at the end of five weeks with mediastinal abscess. In the other case I made a preliminary gauze packing in the neck around the trachea, but did not perform a preliminary tracheotomy. In this case I brought the isolated upper end of the trachea forward to the skin and anchored it. The entire isolated portion

necrosed, as did also a portion of the trachea beyond the isolated part. As a result pus was inhaled into the respiratory tract below the level of the sternum. An autopsy showed no pneumonia and no mediastinitis, but a septic tracheitis and bronchitis. Death was the result of local absorption, and of absorption from the trachea and from the bronchial mucosa. This case demonstrated most conclusively the efficiency of the granulation barrier which is created by a preliminary iodoform packing. Had I made a preliminary tracheotomy, or had I allowed the trachea to remain in its bed, the patient would surely have recovered.

In 16 of these 27 laryngectomies for cancer the laryngeal box was so choked with the growth that tracheotomy was required to prevent suffocation. Most of my patients gave a long history of hoarseness followed by gradual, though intermittent, obstruction to respiration. In two cases there was associated lues. One of these last two cases illustrates well the clinical difficulty of diagnosis. The lesion was first diagnosed correctly as luetic, and under a course of treatment the greater part of the growth disappeared. The residual growth, however, showed a progressive tendency, and was later diagnosed as cancer. Laryngectomy was performed and the patient is now alive and well, more than three years since his operation. The special lesson from this case is that cancer of the larynx, like cancer of the tongue, may follow local luetic lesions. There is danger, therefore, that the hope of a luetic cure may defer too long the laryngectomy which is the only chance for the cure of the cancer.

As the lymphatics are involved in extrinsic cancer, a much wider dissection is required. As already stated, operation in cases of extrinsic cancer is but a palliative remedy, but even in such cases total laryngectomy is advised, because local recurrence comes more surely and more quickly if one cuts into the growth.

Summary.

Surgical experience has demonstrated that intrinsic cancer cannot invade hyaline cartilage; that it tardily, if at all, metastasizes; that it frequently follows in the wake of benign tumors and of syphilitic ulceration; that the immediate mortality is now well controlled; that the disability and deformity of the laryngectomized patient should have no weight in deciding for or against the operation; that special training and experience are required to thoroughly master the technic; and that if recognized early, and removed completely, intrinsic laryngeal cancer is perhaps the most curable cancer of the body. In view of the results obtained, there is no longer any justification for the pessimism which still disheartens the victim of laryngeal cancer and prevents him from utilizing his one chance of life.

I. THE EXCISION OF BOTH LOBES OF THE THYROID GLAND FOR THE CURE OF GRAVES'S DISEASE. II. THE PRELIMINARY LIGATION OF THE THYROID ARTERIES AND OF THE INFERIOR IN PREFERENCE TO THE SUPERIOR ARTERY.*

BY WILLIAM S. HALSTED, M.D.,

OF BALTIMORE, MARYLAND.

I. In 39 cases of Graves's disease for the cure of the hyperthyroidism it has been necessary to excise, at two or more operations, the greater portion of both lobes of the thyroid gland. Several of these patients, operated upon as long ago as 1902 and 1903, are still under observation and in quite perfect health.

In all of these cases the second lobe was removed because excision of the first had been followed by insufficient improvement. In several instances in which the ligation of three arteries plus the excision of one lobe had been attended with almost negative results, relief from all symptoms followed immediately upon the removal of the remaining lobe; hence the advisability, repeatedly emphasized by Dr. Halsted in his publications, of operating upon the first lobe in such manner that the second may be excised without danger of tetany. A small slice of each thyroid lobe is left in order to protect the circulation of the parathyroid glandules. The operation is performed in an absolutely bloodless manner, all of the blood-vessels supplying the lobe being clamped (but not ligated until after the lobe has been cut away) at a safe distance from the parathyroids.

No muscles are divided in the course of the operation except a few of the fibres (usually the posterior fibres) of the sternothyroid. Hæmostasis is attended to with scrupu-

* Read before the American Surgical Association, May 7, 1913.

lous care and the wounds are closed without drainage. There has been no death in this group from operation although, in general, it includes the most serious cases, so serious that, in the majority of them, preliminary ligation of one or more arteries was done. In one case the four arteries were tied, at as many operations, before the lobectomy was hazarded.

Kocher having emphasized the importance of lymphocytosis in hyperthyroidism, a differential leucocyte count has been made. Almost invariably the proportion of lymphocytes was increased, once being as high as 65 per cent. But in one case, the most serious of all, the total percentage of lymphocytes was only 9. It has particularly interested Dr. Halsted to observe that there has been a gradual reduction, after operation, of the lymphocytosis in these cases.

The role of the thymus in Graves's disease is probably of great importance. With the advances in skiagraphy it has become possible to detect enlargement of the thymus too slight to be determined by percussion. It seems probable that in a very considerable large percentage (75 per cent. or more) of the pronounced cases the thymus is enlarged.

The hyperplastic thymus may be in great measure responsible for the disproportionate number of the mononuclear leucocytes. In one of the cases, a boy, aged sixteen years, with only mild hyperthyroidism, the lymphocyte percentage was 56, and there was enlargement of the thymus so great that Dr. Halsted could easily remove a part of it from the ordinary collar incision of Kocher.

In none of the cured cases which returned for observation during the past winter was evidence of persistence of the thymus found skiagraphically, and in none of these was the percentage of lymphocytes above 33.

The tendency, after removal of one lobe, is toward lessening the hyperplasia in the other. This tendency is probably greatest in the cases which improve most. In these, unfortunately, we have no opportunity to see the other lobe, for there is no indication to excise it.

When the second lobe is removed it is always because

patients are not sufficiently benefited by the removal of the first lobe.

In some the second operation is done promptly (two to four weeks after the first) and in these the interval is so short and the improvement from the first operation so slight that great change in the histological picture is not to be expected.

And when the interval has been long the second operation may have been delayed by the patient until she is in worse condition than originally, and the hyperplasia has become correspondingly advanced.

Sometimes the second lobe has been removed several years after the first and when the patient was still vastly better than before the first lobectomy. In these patients the improvement in the histological picture may be considerable.

II. It happens that in no instance have we found that the preliminary ligation of two, three or even of the four arteries sufficed to cure the patient seriously ill with Graves's disease, although we have observed that considerable improvement, for a short time at least, may follow the ligation of even a single artery. Ligation in our clinic has been practised only in the most serious cases and always with a view to improving the patient's condition to such an extent that lobectomy might safely be performed and to testing her resistance to operation, hence I have endeavored to reduce the preliminary procedure to the simplest possible terms, ligating each artery through a space just large enough to admit of exposure of the vessel—a space too small, as a rule, to admit more than one finger. For the past two years or more I have tied the inferior in preference to the superior arteries and for the following reasons:

1. The cosmetic effect is better. The incisions for ligation of the superior vessels have to be made at a higher level than the Kocher collar incision, which is invariably employed for the lobectomy, and there results, in consequence, a well-like band of skin between the two horizontal cuts which is a pronounced disfigurement.

In tying the inferior vessels the incisions correspond, as I

have said, precisely to the line of the lobectomy wound of the skin; and in the making of the latter the fine scars of the former are excised.

2. The wounds made for ligation of the inferior arteries are partly outside of the field of the lobectomy operations, whereas, when the superior arteries have been ligated, a considerable part of the operation for removal of a lobe is through freshly healed, matted tissues whose resistance to infection is lowered. Although suppuration is not very likely to take place even when two or three operations are performed at short intervals through the same tissues, the reaction is greater and breaking down of the wound quite possible.

3. As the inferior thyroid artery is usually larger than the superior, the effect of the ligation may be greater.

4. The superior artery, or arteries, are regularly tied in the course of lobectomy; hence when both inferior arteries have been tied and a double lobectomy is performed all four of the thyroid arteries will have been occluded. On the other hand, if the superior arteries had been ligated at the preliminary operation, the portions of both lobes remaining after a double lobectomy would receive a fuller blood supply.

5. The location of the inferior artery is less variable than that of the superior vessel, which is subject to great changes because of the inconstant position of the superior pole.

The ligation of all the structures of both superior poles through an incision which stretches across the neck—a procedure which has considerable vogue—does not seem quite rational to me for the reason that the results would not be likely to be adequately proportionate to the magnitude of the operation. The ligation of all four of the arteries through small incisions such as I have described, would hardly be more formidable than the operation just referred to and the benefits would, I believe, be greater.

The danger of tetany from the occlusion of the four arteries is probably not so great as I formerly supposed, provided that the ligations are done neatly and at safe distance from the parathyroid glandules. Ligation of the four arteries

in close proximity to the parathyroids and through large incisions might result quite differently. In three instances, in which I have ligated the four arteries in two or more acts and subsequently removed the greater part of both lobes in the manner about to be described, transient symptoms of tetany manifested themselves.

The inferior thyroid artery is ligated as follows: A transverse cut, from 4 to 4.5 cm. in length, is made over the tendon of the omohyoid muscle precisely in the line of the Kocher collar incision as contemplated for the subsequent lobectomy. The fibres of the sternomastoid muscle are separated in line of the common carotid artery at the level of the omohyoid tendon. The thyroid lobe is exposed behind the posterior fibres of the sternothyroid muscle and drawn inward by a retractor designed for this purpose. The common carotid is retracted outward by a similar though somewhat shorter instrument and the layers of fascia covering the inferior thyroid artery are divided at the level of the omohyoid tendon. The dissection is then carried out solely with the two long, delicate, blunt dissectors, for the artery is sometimes at a great depth (greatest when the Graves's disease has been engrafted on a colloid goitre), and the space is only large enough, as a rule, to admit one finger between the deeply concave retractors. A special aneurism needle is used for carrying the fine silk ligatures around the artery. The wound is, of course, not drained. The operation, if performed precisely in this manner, is not difficult. Only once have we failed to find the artery in its usual situation; this was about five years ago.

PARTIAL OCCLUSION OF THE THORACIC AND ABDOMINAL AORTAS BY BANDS OF FRESH AORTA AND OF FASCIA LATA.*

BY WILLIAM S. HALSTED, M.D.,

OF BALTIMORE, MARYLAND.

LIGATION of the human abdominal aorta has been made nineteen or twenty times and always with fatal result.

Dubois, Assalini, Bujalsky, Cooper, Keen and perhaps others attempted to occlude the abdominal aorta gradually by means of cleverly devised instruments which, carrying snares of silk, metal or catgut, might be tightened or loosened at will. The instruments traversed the abdominal wall and hence infection was a complication common to all of the methods and defeated the plans of the operators.

In 1904, assisted by Dr. W. F. Sowers, I began a series of experiments on dogs in the hope of finding a safe method of occluding the aorta and curing aortic aneurism. Bands of silver and aluminum curled about the aorta by an instrument constructed for this purpose were rolled tighter by the fingers until the desired degree of occlusion of this vessel was obtained. The abdominal wounds were closed with the expectation that they would have to be reopened one or more times for the purpose of progressively occluding the lumen of the artery. But in the course of our experiments we had opportunities to make trial in the human subject of partially occluding bands on other arteries (innominate, subclavian, carotid, femoral, popliteal) whose blood streams in some instances it seemed unsafe to cut off suddenly and completely, and found that occlusion of an artery, carried to the point of obliterating the pulse, usually sufficed to cure the aneurism, possibly quite as surely as might have been expected of total occlusion. Hence, tentatively, I abandoned the idea of pro-

* Read before the American Surgical Association, May 7, 1913.

gressive closure of the aorta determining, instead, to obliterate the lumen of this vessel, in the attempt to cure its aneurism, to an extent which we had found quite safe in the dog.

I have applied an aluminum band to the human aorta four times; twice in one subject and twice with promising results so far as the cure of the aneurism is concerned. But the experimental work on animals had led me to expect that ultimately the metal bands must cut through the artery because in cases observed for seven months or less the wall of the aorta had become atrophied to the thinness of paper and there was no adhesion between the infolded, attenuated surfaces. That my fears were well founded was proved by an experience in Europe, about eighteen months ago. The patient was an aged woman with dilated and badly functioning heart. The large aortic aneurism was well located for the placing of a band which was applied just below the renal vessels. Within a few days the aneurism, which before operation was distinctly visible from the seats of the operating amphitheatre, was barely discernible at the bedside, and at the end of six weeks had disappeared so completely that the patient was discharged apparently cured. But, walking out of the door of the hospital she was seized with a pain and returned to her bed. The following morning she died from hemorrhage. The aorta had ruptured at the site of the band, but the aneurism was found to be nearly cured.

Stimulated by the result in this case to further experimentation it occurred to me to test the behavior of cuffs and spiral strips of the fresh aorta of one dog when wound about the aorta of another. So on April 29, 1912, I operated upon two dogs, partially occluding the aorta of one of them with a spiral aortic band and of the other with a cuff cut from the same vessel. Strips of aorta were employed rather than of fascia lata, for example, because I hoped that the elastic tissue, in case it did not endure might, at least, serve its purpose for a time sufficient to cure an aneurism.

At the end of two months one of the dogs was killed and

I was pleased to find that the cuff which had been used in this experiment was apparently organized and had not stretched to any appreciable extent. Above the cuff the aortic pulse was forcible, but below the constriction it was very feeble, though countable and accompanied by a thrill.

The other dog operated upon at the same time and in the same manner, except that a spiral band of aorta instead of a cuff had been employed, died (cause of death unascertained) about three weeks after the operation. In this instance the aorta had been almost completely occluded by the spiral aortic strip. The welt-like band had not stretched and seemed to be organized. The aorta, on being split longitudinally, was seen to be greatly wrinkled and almost occluded at the site of the band. Sections of the specimens indicated that the elastic coats of the bands as well as of the included artery were intact.[1] During the present winter I have made about twenty-five similar experiments with encouraging results. We have learned, however, that whereas the spiral bands seem to be perfectly safe there is danger in the employment of the cuffs. In two instances of twelve or more experiments, one of the mattress sutures taken to hold the flaps of the cuffs together cut part way through the cuffs and thus, being brought in contact with the aortic wall, wore a minute hole in the vessel through which the animal bled to death. Such an accident can hardly happen with the employment of the spiral strip, for not only is the strain on the stitches very slight when this form of band is used, but even if it were so great that a thread might cut through the spiral at any point, it could hardly be brought to bear upon the aorta in such way as to wear into its wall.

To each end of the band of fresh tissue a narrow tape is sewed to facilitate the manipulation of the transplant, which is wound twice about the aorta. When one or two stitches

[1] These observations were briefly reported a year ago in a footnote to an article entitled "The Effect of Ligation of the Common Iliac Artery on the Circulation and Function of the Lower Extremity." The *Johns Hopkins Hospital Bulletin*, July, 1912, p. 217.

have been taken at one end to hold the contiguous edges of the spiral together at this point, the other end of the strip is pulled upon until the aorta is occluded to a little more than the desired amount, and then two additional stitches are taken to maintain the constriction.

Within the past few weeks I have examined the bands of aorta, fascia lata and chromicized submucosa which had been wound about the aorta last autumn and winter. In two instances in which considerable constriction of the aorta had been made about four months previously, kymographic tracings of the blood pressure in the femoral and carotid arteries were made in the physiological laboratory by Professor Howell and Mr. Cecil. To our surprise there was no diminution in the femoral pressure, and on investigating the band it was found in each instance to have relaxed and to have been partially absorbed.

In dogs operated upon as long as seven months ago there was considerable absorption of the band; and in one instance only a trace of it remained. One spiral band which had been applied so as to make almost total occlusion seven months before seemed microscopically to be well preserved, but it no longer constricted the aorta, the lumen of which was completely restored, and whose underlying wall was apparently normal.

These findings do not discourage me, for if the constriction can be maintained for two months or even one month, it might effect the cure of an aneurism, and if not, a totally occluding ligature might perhaps, after such lapse of time, be applied without great risk, and possibly the aneurism in some cases might then be excised. The desirability of transplanting, when feasible, a segment of vessel must always be borne in mind.

About three weeks ago I received from Dr. Francesco Nassetti a reprint of a paper by him entitled "Avvolgimento di vasi Sanguigni con lembi liberi di aponeurosi," and published April 26, 1912, in the *Atti della R. Academia dei Fisiocritici in Siena*. Dr. Nassetti's experiments were made in the

Instituto di Pathalogia Speciale Chirurgica della R. Università di Siena, which is under the direction of Prof. A. Salomoni. His first experiment (a band of fascia about the carotid artery) antedates mine by fifty-six days, and his article appeared about three months before the publication by me of a brief account of my first experiments with spiral strips of aorta (*Johns Hopkins Hospital Bulletin,* July, 1912, p. 217). Dr. Nassetti has written on the cover of the reprint which he kindly sent me that his article appeared in print April 26, 1912. My first experiment with the bands of fresh aortic wall was made April 29, 1912, three days after the publication of Nassetti's report. Hence the credit for the idea of constricting blood-vessels with bands of fresh tissue belongs, I am happy to say, to Italy, the country of the famous surgeon, Luigi Porta, who was, I think, the first to attempt the partial occlusion of an artery. I have the impression that Porta used for this purpose a strip of diachylon plaster.

THE SURGERY OF THE PULMONARY ARTERY.*

BY WILLY MEYER, M.D.,

OF NEW YORK.

Attending Surgeon to the German and Post-Graduate Hospitals.

ANATOMY.

THE trunk of the pulmonary artery is easily accessible: On longitudinal incision of the pericardium to the outside of the plexus made up of the left phrenic nerve and vessels which run right on the surface of the sac, the first vessel encountered is the pulmonary artery. Its direction is obliquely upward and backward toward the left. The forefinger or a large curved sound introduced right below it in a backward and upward direction toward the right of the patient, enters the transverse sinus of the pericardium (see Fig. 1) and passes around the artery and the ascending aorta which latter lies on the right side of the pulmonary artery. Both vessels are intimately connected by means of connective tissue and are surrounded by the same layer of the visceral pericardium; it is impossible to separate them. There is no defined sheath of the pulmonary vessel, a thin layer of subserous fat presents itself after the pericardium has been opened. The main trunk of the pulmonary artery lies almost entirely within the pericardium and is about five centimetres (two inches) long. At the concave border of the aortic arch the vessel divides into the right and left branches. The right, longer than the left, turns downward and backward around the ascending aorta, passes the superior vena cava, and divides into two branches, an upper and a lower one (Fig. 1), at a level with and right above the right bronchus, before it enters the hilus of the lung. Further on, these two again divide, the pulmonary artery branch always running "to the north" of the respective bronchus. This is an important

* Read before the American Surgical Association, May 7, 1913.

anatomical point. The left (shorter) main branch of the pulmonary artery first continues in the original direction of the parent trunk, but soon turns downward in front of the left bronchus and the descending aorta toward the hilus of the left lung. There are many varieties in the subdivision of the pulmonary vessels.[1]

OPERATIONS.

I. *Removal of Pulmonary Emboli. Trendelenburg.*

In man the best method known at present of obtaining access to the main trunk of the vessel is that devised by Trendelenburg. In experimental surgery upon dogs, an intercostal incision in the third or fourth space with use of rib-spreader suffices for proper access.

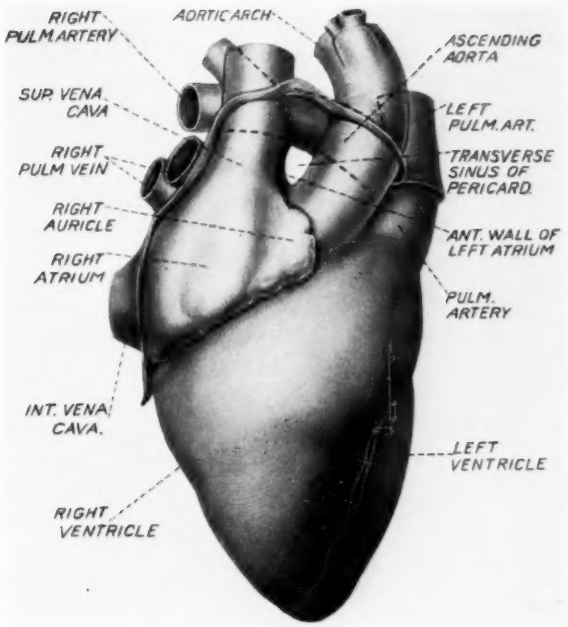
Trendelenburg's operation, as finally worked out, is briefly as follows: A horizontal incision about ten centimetres long is made upon the left second rib, beginning at the left border of the sternum and dividing skin, fascia and fibres of the pectoralis major muscle. This is crossed by a perpendicular cut which starts right below the sternoclavicular articulation and passes the cartilage of the third rib about one inch outside of the sternal border; it avoids the left internal mammary artery (Fig. 2, *a*). The two triangular flaps with underlying muscle are turned back (Fig. 3), isolation and division of the second rib outwardly. In raising and twisting its sternal portion the cartilage breaks; this portion of the rib is removed; division of the third cartilage in a perpendicular line. Usually by this time the pleura has been opened and the use of differential pressure is welcome, provided time and a sufficient number of assistants are at the surgeon's disposal. If the pleura had not been opened a ⊢ incision through it, corresponding to the outer one, has to be made (see Fig. 3). The lung is allowed to collapse somewhat and thereby the pericardium exposed. Upon it the phrenic nerve with phrenic vessels become visible. Inwardly of the same the pericardium is in-

[1] Cf. E. D. Schumacher: Verhandl. d. Deutschen Gesellschaft fuer Chirurgie, 1911, pg. 246; and v. Langenbeck's Archiv., vol. 95, pg. 536.

cised at the level of the third rib and the wound lengthened in an upward and backward direction until the entire upper half of the pericardium is divided; the lower half remains closed and the heart itself in its normal position. All this can be well done within five minutes. A rubber tube with the help of Trendelenburg's sound (Figs. 3 and 4, *a*) is then quickly drawn through the transverse sinus of the pericardium around the ascending aorta and pulmonary artery, held, and pulled upon for compression by an assistant, immediately before the surgeon punctures the vessel with a sharp-pointed bistoury. The presenting thin layer of fat with the visceral pericardium having been torn, if time permits, with care between two anatomical forceps, the wound in the arterial wall is lengthened for about one centimetre (½ inch). Without a moment's loss of time a specially curved, blunt forceps (Fig. 4, *b*) is introduced, first into the main artery, then into its branches, the thrombus or thrombi grasped and extracted (Fig. 5). Only 45 seconds are at the disposal of the surgeon for this, the principal part of the operation, since observations have shown that the interruption of the circulation in this part of the body is not tolerated longer. Now the lips of the vessel wound are lifted up by special forceps (Figs. 4, *c* and 6 *a*), and temporarily closed by a clamp (Figs. 4, *d* and 6), after which the assistant interrupts the elastic compression. Circulation therewith having been re-established, the heart immediately begins to work, often violently, if the patient had not died before. If needs be, the manœuvre of compression, reopening of the arterial wound and introduction of forceps can be repeated. Closure of the wound in the pulmonary artery by interrupted silk sutures is rendered easier by pulling at intervals on the elastic tube, which will put the artery at rest for a few seconds. Closure of the wound of the pericardium and chest wound according to ordinary surgical rules.

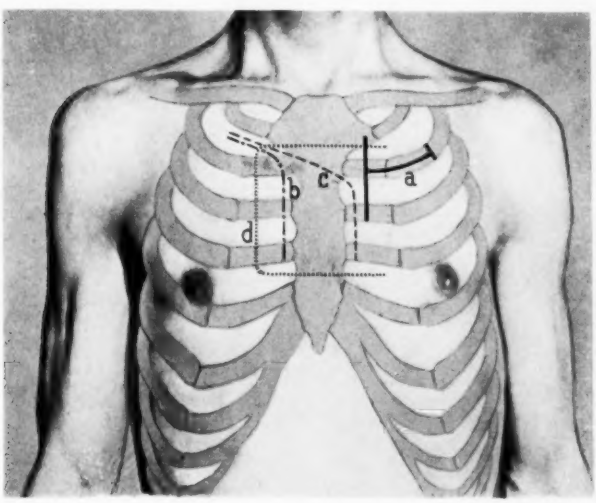
Trendelenburg's experience in animal experiments was obtained on calves, without the use of differential pressure; dogs were not considered suitable subjects. A piece of lung,

FIG. 1.



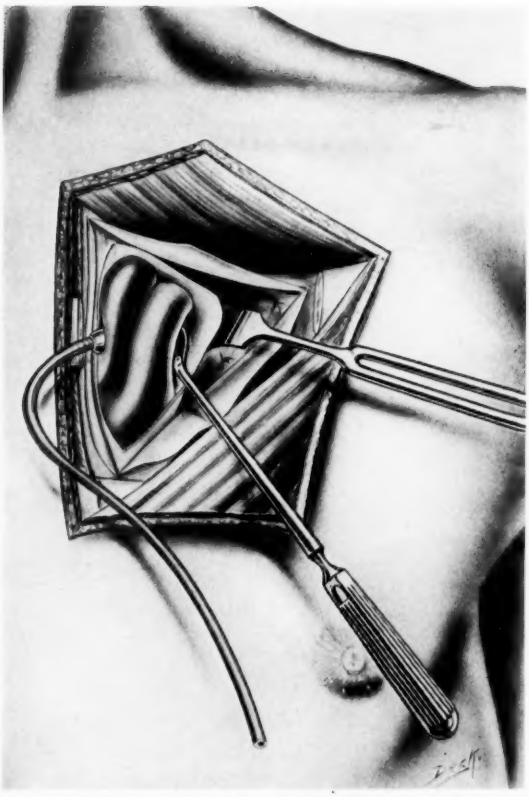
Heart seen from the right side. Note the upper entrance into the transverse sinus of the pericardium (which appears larger than normal, due to the process of hardening the specimen), also the transverse course of the right pulmonary artery behind ascending aorta and superior vena cava as well as its division at the right border of the latter vessel. (Taken from the book on "Topographic-Anatomy" by Oscar Schultze.)

FIG. 2.



Incisions for exposing the heart and large blood-vessels. *a*, for Trendelenburg's operation. *b* and *c*, originally considered useful for reaching the right pulmonary artery for ligation between ascending aorta and superior vena cava. Experiments on the cadaver have shown both to be inadequate. *d*, trap-door flap, which appears recommendable. It involves resection of second to fourth right costal cartilage with a piece of the adjacent ribs, ligation of the internal mammary plexus in second and fourth intercostal space on both sides, transverse division of the sternum at same levels, raising flap and turning it over to left of patient.

FIG. 3.

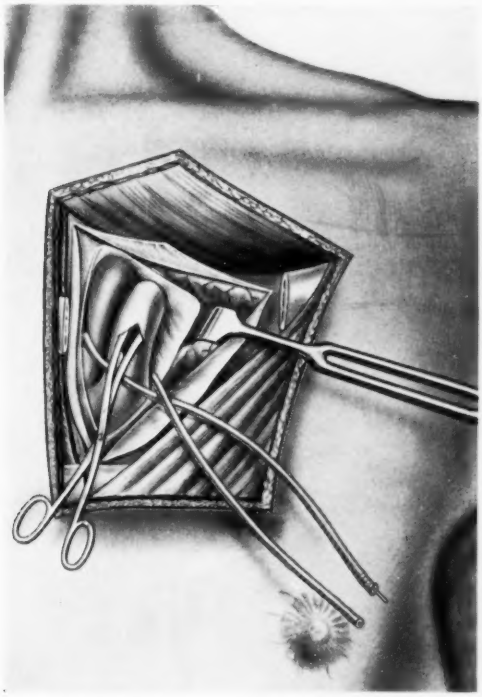


Trendelenburg's operation for the extraction of pulmonary emboli. ⊢ incision alongside left border of sternum, and over median portion of second left rib; the latter with cartilage resected; third costal cartilage divided. Triangular flaps turned back. Pleura incised; pericardium opened. Trendelenburg's large sound has passed through transverse sinus of pericardium, lifts pulmonary artery plus ascending aorta forward. Elastic tube screwed on; ready to be drawn around vessels.

FIG. 4.

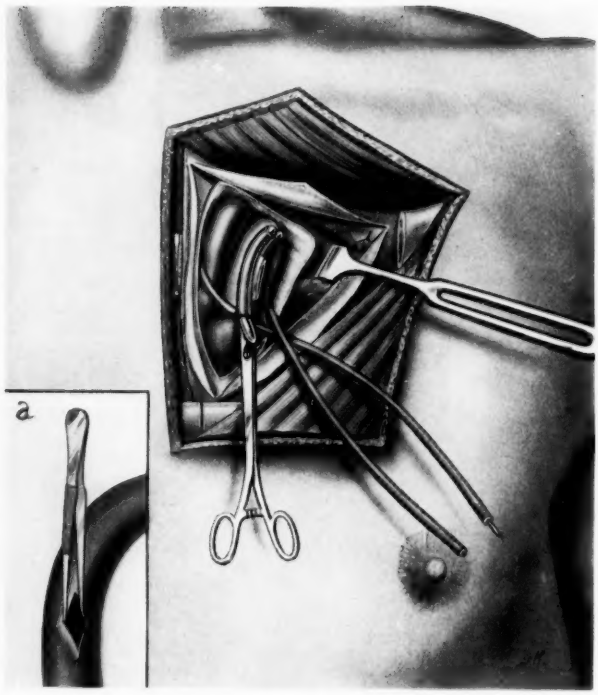
Instruments devised by Trendelenburg for his operation. *a*, large curved sound with handle, elastic tube detached; *b*, blunt pointed forceps for extraction of emboli; *c*, forceps with tips turned outward, which lift the borders of the incised wound of the pulmonary artery (see Fig. 6*a*); *d*, clamp with rubber covered branches, which closes the arterial wound (see Fig. 6).

FIG. 5.



Elastic tube tightened by assistant, compressing both vessels (not shown in illustration). Pulmonary artery incised and forceps introduced for extraction of emboli.

FIG. 6.



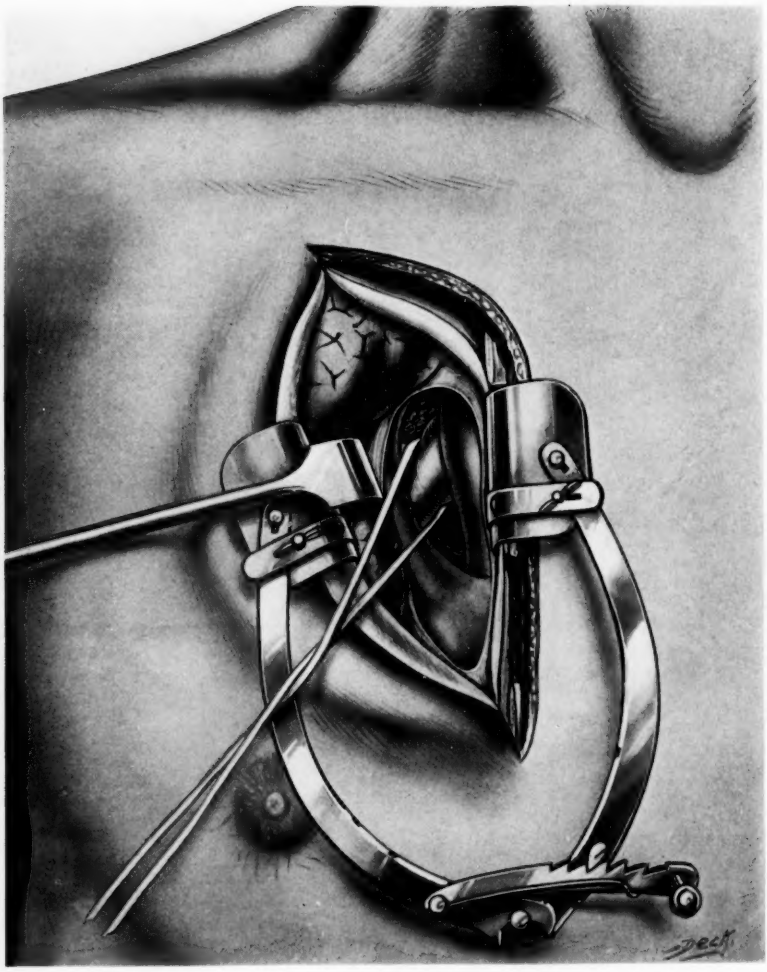
Longitudinal wound in pulmonary artery clamped laterally, permitting blood circulation alongside during the act of placing the interrupted sutures.

FIG. *6a*.—Forceps introduced to facilitate lifting and proper clamping of artery.

FIG. 7.

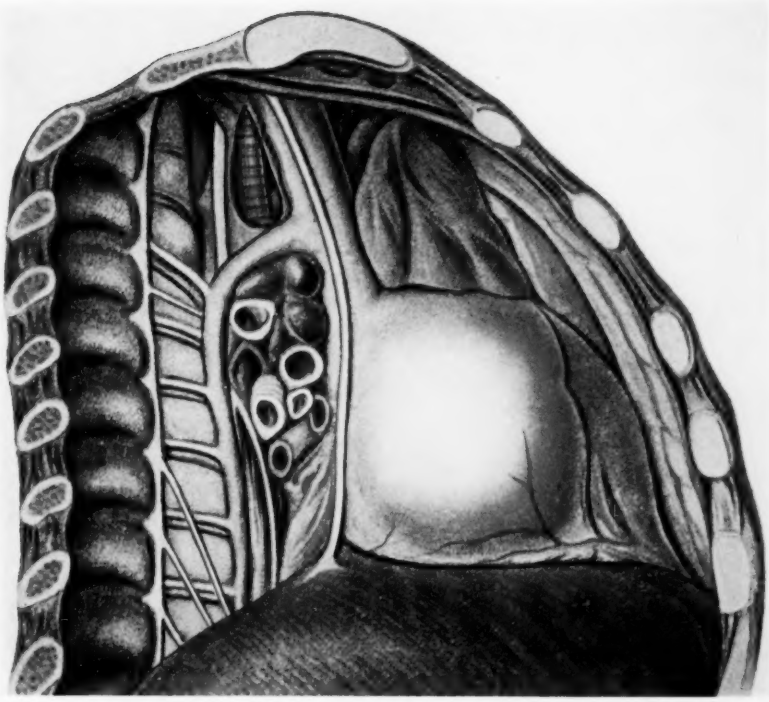
Bronchiectasis of inferior lobe of left lung, obtained by pneumectomy (personal collection). Actual size of specimen, divided by section cut. The pronounced distention and contortion of almost the entire bronchial tubes is well marked.

FIG. 8.



Ligation of right pulmonary artery within the pericardium. Illustration somewhat diagrammatic. Cadaver operation, with help of a curved combination incision through first right intercostal space and division plus resection of second till fourth costal cartilage with adjacent portion of ribs. Body turned on left side (not shown in picture), the right shoulder and hip being supported by blocks. Pericardial wound lengthened upward and to the right as far as the finger introduced will find an open space. This brings field of operation well into view. By retracting ascending aorta with a blunt hook toward the median line and the superior vena cava outward, the large right pulmonary artery, running horizontally across the field, becomes clearly visible in the depth.

FIG. 9.



Situs mediastinalis in a child, right side view. Almost the entire right half of the thorax removed, and right lung cut off at its root. Note right phrenic nerve running parallel with superior vena cava, also rectangular entrance of vena azygos into this vessel. Incision through costal pleura above vena azygos added; through this window the trachea is seen. Below the vena azygos appears the bundle of divided bronchi with branches of right pulmonary artery and vein. A few lymphatic glands hug the right border of the large vein. By pulling the angle between vena azygos and superior vena cava downward and to the right and the trachea to the left with a blunt retractor, the place is reached where the right pulmonary artery divides into an upper and lower branch, still within the pericardium. The right uppermost turn of the pericardium must first be divided before the division of the vessel comes into view. (Taken from the book on "Topographic Anatomy" by Oscar Schultze.)

1 cm. thick and 15 cm. long, was removed from another animal at the slaughter house, under aseptic precautions, and introduced through the deep jugular vein into the circulation, everything being in readiness for the subsequent work. As soon as the symptoms of pulmonary embolism became manifest in the narcotized animal, access to the pulmonary artery was obtained in the manner described above, and the embolus extracted; it had become lodged in the left branch of the vessel. The calf, eight weeks old, recovered from the operation (December, 1907). The specimen of the heart and adjacent large blood-vessels was obtained 3 months later and demonstrated before the German Surgical Congress at Berlin, April, 1908.

Shortly before this presentation the operation was carried out by its author for the first time in the human being. The patient, 70 years old, died before the operation was finished. Since then it was done, according to a personal communication from Prof. Trendelenburg, dated January 31, 1912, twelve times in all, at the Leipzig clinic, without one permanent recovery. One patient lived for four days; another one, operated upon by Krueger, survived the operation, but died five days thereafter of pneumonia.

Prof. Trendelenburg writes: "All new and difficult problems require much work, favorable conditions and unfaltering confidence and perseverance. This holds good also in the operation for pulmonary embolism. Twelve times have we done it at the clinic, my assistants oftener than myself, and not once with success. And yet, I would continue trying. This much we have learned from our cases, that the diagnosis in all *surgical* cases is easy; invariably did we find the emboli."

Trendelenburg's operation is nicely adapted to the endeavors of present times. The ideal way of dealing with an acute arterial embolism is to cut down on the seat of the thrombus after proper localization, remove it and close the rent of the arterial wall by suture. Trendelenburg deals with the most common of embolic troubles which, if left alone, is frequently fatal. He has succeeded in overcoming the tech-

nical difficulties that seemed at first glance to block the way. The steps of his operation are clearly defined.[2]

If it could be shown that patients can entirely recover after the operation, surgeons would, no doubt, be less inclined to temporize, but would operate as soon as the diagnosis has been made.

All operators speak of the enormous distention of the right ventricle of the heart after the onset of the catastrophe, which, as a matter of necessity, increases from minute to minute.

Trendelenburg's assistants, Laewen and Sievers, on the basis of experimental work, recommend artificial respiration with oxygen during the operation, and injections of adrenalin into the left ventricle, immediately after the elastic compression of the vessels has ceased.[3] They also found that whereas aorta and pulmonary artery can be compressed for 45 seconds only, the two venæ cavæ may be compressed for six to eight minutes without endangering life, a point which had already been emphasized by Sauerbruch previously. The explanation is that in the former case the distention of the right heart is added to the interruption of the circulation. On basis of these findings, Jeger [4] proposes compressing the two big veins, when carrying out Trendelenburg's operation, rather than the two big arteries. In his experiments along these lines he found that he could do the incision and closure of the pulmonary artery leisurely. The incision of the pulmonary artery brought immediate relief to the distended right heart. He thinks it might be still better to commence work on the heart with puncture of the right ventricle.

According to Trendelenburg, coagulation of the blood and recurrence of the embolic accident can be avoided by injections of hirudin.

His assistants, Rimann and Wolf, investigated this question.[5] They found that one milligramme hirudin prevents the

[2] See Trendelenburg: Centralbl. f. Chirurgie, 1907, pg. 1302; ibid., 1908, pg. 92, and No. 35, Beilage, pg. 3; Deutsche med. Wochenschrift, 1908, No. 27; R. Sievers: Deutsche Zeitschrift für Chir., vol. 93, pg. 282.

[3] Deutsche Zeitschr. f. Chirurgie, 1910, vol. 105, pg. 174.

[4] Die Chirurgie der Blutgefasse u. des Herzens, 1913, pg. 243.

[5] Deutsche Zeitschr. f. Chir., vol. 97, pg. 177.

coagulation of 5 c.c. of blood for four and one-half hours. This would mean for a patient of average weight 1 gramme (fifteen grains), at present a rather expensive procedure, as the cost of one gramme hirudin is almost twenty dollars. The drug, injected intravenously in large amounts, proved harmless.

Some authors have called Trendelenburg's operation of little practical value, because, if the embolus is large, the patients die within a few minutes, and if it is of smaller size, it often does not endanger life and the patients do not need operation.

However, according to Trendelenburg's experience, there remains a certain proportion of patients, at least 50 per cent., in whom only one branch of the pulmonary artery becomes obstructed at first, and death does not occur until 10–60 minutes after the onset of the embolic attack. These patients present a clear indication for his operation. At least 15 minutes are usually at the disposal of the surgeon. Assistants and nurses must be trained to recognize the attack.

Unfortunately, the ever-continuing rotation in the staff of doctors and nurses in the hospitals of our eastern states minimizes this help or makes it illusory. But wherever permanency of position has been introduced, pulmonary embolism will be readily suspected or recognized, after attention has been called to the pathologic picture.

There remains, to my mind, another serious obstacle, particularly in our country, viz.: the necessity of obtaining the consent of the patient or his relatives without which this operation should not be undertaken, as otherwise conflicts with the law might be incurred by the surgeon. To obtain the consent to such an eventuality prior to the performance of the first operation, will seriously embarrass the operator's position; to ask for it after the embolus has occurred, almost without exception means fatal delay.

At the last meeting of the Congress of German Surgeons, March, 1913, Schumacher presented the experience gathered with Trendelenburg's operation in Sauerbruch's clinic at

Zurich. He calls attention to the fact that the diagnosis of pulmonary embolism may be difficult because a suddenly occurring internal hemorrhage, also myodegeneration of the heart can produce like symptoms.

Regarding diagnosis he considers, next to the clearly demonstrable enlargement of the right heart, the accentuation of the second pulmonary sound of importance.

He distinguishes three classes of pulmonary embolism:

1. The one causing immediate exitus, which evidently is due to shock, as not infrequently only a partial thrombosis of the artery may be found at autopsy.

2. The one causing death within a few minutes. Here thrombosis is perfect, separating pulmonary and greater circulation. The right heart becomes quickly overdistended.

3. The one of protracted course, which is most frequently observed. Here one of the main branches of the artery and a subdivision become suddenly clogged; only gradually total obstruction sets in.

As a matter of fact only the third category will furnish cases with indication for operation, and the task of establishing this indication is rendered difficult on account of the experience that some of these patients get better under conservative treatment. He considers operation imperative if medical treatment fails to bring improvement.

Four times this operation was performed at the Zurich clinic, but the patients could not be saved.

How much less dangerous the use of differential pressure has rendered Trendelenburg's operation in experimental surgery and operations on the heart in general, is shown by the results of operations upon dogs—animals which were not considered as suitable for this purpose. Of three dogs operated upon by myself with the assistance of Dr. Martin Rehling, adjunct attending surgeon at the German Hospital, two recovered, although the instruments used in human beings had to be employed (by far too large a set for the smaller dimensions of the dog).[6] The third dog succumbed to the

[6] One of these dogs was presented before the New York Surgical Society, May 8, 1912.

results of an empyema on the twelfth day after operation.

Tiegel's apparatus appears to be best adapted for these emergency cases in man.

There certainly does not seem to be any good reason why Trendelenburg's operation should not be successfully performed in the future also on man. I feel sure that with the future evolution of thoracic surgery the large hospitals here and abroad will follow Trendelenburg's advice, to keep an instrumentarium for this work ready for instantaneous use in a specially labeled package, and make an effort to save also this class of patients, so often utterly lost without operative help.

II. *Intrapleural ligation of branches of the right or left pulmonary artery for bronchiectasis. Sauerbruch-Bruns.*

Bronchiectasis involves the bronchial tree, not the pulmonary tissue (See Fig. 7 and ANNALS OF SURGERY, vol. 52, pg. 40, Fig. 1). It is a frequent disease. In tuberculosis sanatoria and other places many patients are found who expectorate large amounts of pus and mucus, often mixed with blood and of foul odor and taste, in which, on repeated examination and inoculation of guinea-pigs, no tubercle bacilli can be demonstrated. The majority of these patients suffer from bronchiectasis. Clinical examination often brings out nothing characteristic except a few crepitant râles, usually over the lower lobe of one or both lungs; on the right side, the middle lobe is often also involved. Cases have likewise been found in which the upper lobe was affected.

Bronchiectasis is also a dangerous disease. Remarkable to state, sudden suppurative inflammation of brain and cord may follow in its wake. Personally, I have lost three such patients of a most acute purulent meningitis following preliminary incision of the lung for bronchiectatic cavities, from three to six months after the operation among ten patients thus afflicted. They died within 48 hours after the onset of the acute symptoms.

The clinical symptoms of bronchiectasis are not amenable to medicinal, serological or hygienic treatment, as in pul-

monary tuberculosis. They gradually but continually remain on the increase. In most instances the exceedingly foul odor and taste of the sputum torment the patients and their families beyond expression; the frequency of the expectoration interferes with their night's rest.

With the advent of thoracic surgery, bronchiectasis has, therefore, clearly become a surgical disease, which *after* operation has to be considered a disease of the borderland.

Inasmuch as this article deals merely with the surgical aspects of the pathologic condition and more particularly with the surgery of the pulmonary artery, in respect of them only the operative procedures for bronchiectasis will be mentioned.

A. Artificial pneumothorax by insufflation of nitrogen into the pleural cavity.

This is a recommendable treatment where there are no adhesions and where the pulmonary parenchyma is the seat of the disease. But in bronchiectasis, in which the bronchial tree is the affected part, no lasting result can be expected from outside compression of the lung by gas. Vollard reports a case of bronchiectasis, treated with artificial pneumothorax for two years and a half (*Muench. med. Wochenschr.*, 1912, No. 32); the sputum was temporarily reduced; but upon discontinuance of the treatment the sputum promptly returned to its original quantity. More lasting results may be obtained by collapse of the lung by means of thoracoplasty.

B. Incision of the bronchiectatic lung abscess (pneumotomy).

Cures have been reported after this operation. They are exceptions, however. Usually the expectoration is for a time considerably reduced thereby, since a part of the bronchiectatic cavities drain through the chest wound. However, with advance in cicatrization, the sputum increases again. When cures have been actually obtained they have usually not been lasting, relapses having been frequently observed.

C. Partial thoracoplasty combined with pneumolysis, and transposition upward of the diseased lobe of the lung by suture, tamponade of the pleural cavity between base of lung

and diaphragm with healing of the wound by granulation (Garré[7]).

D. Ligation of the branches of the pulmonary artery. Sauerbruch-Bruns.

Before the third International Congress at Brussels, September, 1911, Sauerbruch reported two cases thus treated. In his experimental work, done in connection with Bruns,[8] he had found that if the branch of the pulmonary artery which conveys the venous blood to the lung for ventilation was tied, in other words, if the physiologic function of that lobe was artificially inhibited, it would shrink, become adherent to the costal pleura and become transformed into a mass of connective tissue. When, later on, thoracoplasty is done, as in unilateral tuberculosis of the lung with cavity formation, the bronchiectatic cavities are compressed by the collapse and the proper, logical way for the improvement or cure of the trouble has been opened. Sauerbruch's patients, up to the time of the report, had been much improved.

So far I have employed this method in three cases. Their histories are here very briefly appended:

Case I.—J. C., male, seventeen years old; right lung, middle and lower lobe affected; expectorated for five years following attack of pneumonia; never T. B. found; lues negative; sanatorium treatment over two years; no improvement.[9] Clinical symptoms slight, point to right, middle and lower lobe; corroborated by X-rays. Quantity of sputum 350–400 c.c. in 24 hours; mucopus of foul odor, mixed with blood.

Operation (April 4, 1912).—Previous forced expectoration; regional anæsthesia, with novocain 1 per cent. + suprarenin (Hoechst's tablets, freshly dissolved), of fourth to seventh thoracic nerves, inclusive; negative chamber; expectorates almost 100 c.c. during the first three-quarters of an hour of operation. Left lateral position; incision in right, fifth intercostal space, after previous injection with novocain solution, painless; rib spreader put in place; patient still has no pain, but does not like

[7] Mittheilungen aus den Grenzgebieten, vol. xxiii, 3.

[8] Centralblatt f. Chir., 1908, pg. 1405.

[9] This patient was sent to the German Hospital for treatment through the courtesy of Dr. McSweeny, then physician-in-chief of the tuberculosis sanatorium in Otisville, N. Y.

to be awake, asks for general anæsthesia; granted, very superficial. Lung widely adherent, freed up to apex incl. (total pneumolysis); interlobar space closed by tight adhesions, cannot be entered; therefore, ligation of pulmonary branch above and at base of bronchus with silk. Closure of thorax. Patient returned to ward; primary union; out of bed four days later; quantity of sputum diminished; later slowly increasing. Soon goes to country; able to work.

January 17, 1913, increased weight; expectoration about 180 c.c. in 24 hours.

March 13, 1913, thoracoplasty, under regionary novocain anæsthesia; Schede's incision, lower half; sixth to tenth ribs inclusive, resected.

April 1, inhalation of superheated air begun by means of electric hot-air douche; brings little improvement. In near future second to fifth ribs to be attacked by columnar resection in paravertebral and mammillary lines (Wilms).[10] On the whole, patient improved, but so far not cured.

CASE II.—F. N., male, seventeen years of age; expectorated for last five years following pneumonia. Left lower lobe involved; typical sputum; no T. B.; pronounced scoliosis. Nine months in sanatorium, without improvement.[11]

Operation (May 12, 1912).—Negative chamber; regionary anæsthesia, as before; expectorates freely during progress of operation; superficial general anæsthesia, which patient asked for, induced. Intercostal incision in fifth space. Lung adhesions not loosened; artery of lower left lobe identified and ligated (chromicised gut). Portions of lower lobe atelectatic; closure without drainage; soon rise of temperature; middle of wound re-opened; exit of turbid serosanguinous fluid; fever gradually dropped; healed slowly. Returned to sanatorium in July, where he still is; has gained 16 pounds in weight; daily amount of sputum 120 c.c.[12]

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[10] These operations were carried out on May 15, posteriorly, and May 31, anteriorly, under regionary anæsthesia. Primary union followed both operations. Patient is now ready to leave hospital (June 7).

[11] Referred through courtesy of Dr. Rathbun, the present physician-in-chief at the Otisville Sanatorium.

[12] May 15. Thoracoplasty under regionary anæsthesia. Ribs run almost perpendicularly upward. Large Schede incision required. Resection of tenth to sixth ribs inclusive; doing nicely; will soon return to the country sanatorium.

In view of the rigid asepsis carried out, it is assumed that possibly the pulmonary adhesions contained dormant encapsulated bacteria which became virulent after operation.

CASE III.—T. M., male, twenty-two years; five years ago pneumonia; two months in bed; since then abundant expectoration; about one-half cupful every two hours, day and night, often mixed with blood, and of sweetish taste; sleep much interfered with; cannot attend to business; medical treatment brings no relief; clinical examination points to right lung, middle and lower lobe; radiography corroborates this; quantity of sputum 350–400 c.c. in 24 hours.

Operation (February 25, 1913).—Negative chamber; regional anæsthesia, third to sixth thoracic nerves; local in fifth interspace; work painless; rib-spreader produces feeling of pressure, but no pain; manipulations in thorax start cough. No adhesions between costal and pulmonary pleura. Interlobar space can be well entered; field deep; adhesions there clipped with scissors; lung tissue, drawn out into one of these adhesions, injured; exit of some purulent material; bronchus exposed; artery as usual, toward "north" of same; located and freed; two black colored lymphatic glands tightly adherent, loosened with difficulty; pronounced periadenitis; slight venous oozing; at this time a few drops of anæsthol were administered, 8 c.c. in all, but pulse rose; patient became cyanotic; anæsthesia stopped; better; silk ligature around vessel feeding lower lobe; search for artery of middle lobe not pressed on account of patient's condition. In view of contamination of pleural cavity, drainage decided on; counter opening in eighth intercostal space; short cigarette drain and two split rubber tubes introduced; main wound closed; rubber dam over drains; large dressing; differential pressure after treatment for 15 hours. First day satisfactory; then rise of temperature and subcutaneous emphysema of right side of abdomen and scrotum, also up to right side of neck; some dyspnœa. Third day middle of intercostal wound reopened; exit of serous fluid with air; no communication from drainage canal to upper cavity, into which two rubber tubes are introduced; lower lobe of lung had already become tightly adherent to chest wall; gradual improvement.

March 15: Beginning to inhale superheated air produced by electric hot-air douche, four times in 24 hours, gradually up to

40–45 minutes each time; improvement continues; sputum reduced to 30 to 60 c.c. within 24 hours. Wounds closed; has gained in weight; sleeps all night. Thoracoplasty deferred for the present.

Regarding the technic of the operation, it must be stated that it is not as simple in the human being as it is in the dog. In the latter the pulmonary lobes are clearly divided; broad, pleuritic bands, if present, can be easily and safely cut and the bronchus with accompanying vessels exposed. In man the lobes of the lung often form a unit, with adhesions between them, the thicker the oftener attacks of pleurisy have been experienced. The interlobar space can be entered, but the bronchus with its vessels is not always reached without injury to the lung tissue; and when thoroughly exposed, the bronchus may be found covered by a few enlarged and inflamed lymph nodes, as in my Case III, which render isolation of the artery in the depth difficult, if not impossible. Besides, the variations in the division of the pulmonary artery, so thoroughly discussed by Schumacher in his lucid article (*l. c.*) leave the surgeon in doubt whether all the vessels that should be tied have been tied.

In view of these facts the desire to reach the right and left arteries before their division into branches, viz., nearer the heart, was but natural. This desire has become all the more intense, since two patients with bronchiectasis lately have come under treatment, in whom a strict localization of the trouble has thus far been impossible. One has been operated upon repeatedly for a bronchiectatic lung abscess on the right side before coming under my care; the other has an affection also of the right lung with a pulmonary hemorrhage off and on, and clinical signs of disease pointing to the right middle and upper lobe.

The experimental work which I have carried out with Dr. Rehling within the last few months, has in part been directed toward the solution of this question. Anatomical studies have shown that it will be best for the purpose in view to ligate the trunks themselves, of either of the two arteries. This is best done within the pericardium.

III. *Intrapericardial ligation of the main trunk of the left and right pulmonary artery (experimental).*

In dogs it is a comparatively easy matter, after having entered the pericardium, through a left intercostal incision in the fourth space between the left phrenic plexus and the left pneumogastric nerve, to separate the left portion of the pericardium, after a very superficial incision of its turning fold, for about one centimetre from the left pulmonary artery, and then surround the vessel with a ligature. (Not infrequently the left pulmonary artery in dogs divides a few millimetres outside of the pericardium and can then of course be tied there to advantage.) Closing the artery suddenly has no influence on the heart's action and respiration, as proven by many experiments. If the ligature drawn around the vessel has not been tied, but made use of for gentle traction, the right pulmonary artery can be best surrounded with a thread below the left on its course downward and backward before it reaches the posterior aspect of the ascending aorta. The same can be accomplished from above the left pulmonary branch by preparing off the pericardium upward; but this manœuvre is dangerous, in view of the missing sheath of the vessels, and their great thinness (hemorrhage). The advance from below, therefore, has appeared safer to us. The first and most important rule for this work is, after the pericardial fold has been nipped, to proceed absolutely bluntly, with a curved forceps or scissors, slowly and gently. Only in this way can a sudden severe hemorrhage be avoided.

Work on human cadavers, done at the morgue, and made possible through the courtesy of Dr. S. W. Schultze, of the Board of Health, has shown us that the left pulmonary artery, with Trendelenburg's incision, is as thoroughly accessible in man as in animals, at least in the frozen cadaver, although the field of operation is pretty low if aorta and pulmonary artery have not been lifted up with a rubber tube in the transverse sinus of the pericardium (see above, Trendelenburg's operation). But the right main branch makes such a sweeping curve downward and backward that it seems

unwise and unsafe to attempt here anything like what could be successfully done in the dog. A hemorrhage coming from the right pulmonary artery at this place would most likely mean the death of the patient on the table, except the quick temporary compression of superior and inferior vena cava would allow the operator to find the tear and close it by suture. We have, therefore, attempted to reach the right pulmonary artery on its further course. There are two ways open, one within the pericardium, the other outside of the same. The first place can be reached from the front, the latter from behind. Making it a postulatum that such an operation should not be too severe, the advance from behind has not been favored. We have, therefore, chosen in our experimental work to advance from the anterior side and ligate the artery within the pericardium in the following manner: Right intercostal incision in the fourth space; incision of pericardium (low down! to avoid hemorrhage), splitting of the pericardium upward until ascending aorta and superior vena cava are properly exposed. If these two vessels are then gently, without compressing them, separated with blunt retractors or the fingers, the right auricle being held down and its fibrillation kept under control with a small gauze mop, the transversely running right pulmonary artery becomes clearly visible in the depth (Fig. 1), and can be surrounded with a ligature (Fig. 8). At the present moment this kind of approach seems to us to represent the most favorable one. After some experience this ligation took us, from the beginning of the operation to the application of the dressing, half an hour; the dog recovered.[13]

A little further peripherally the right pulmonary artery divides into a superior and inferior branch which might be reached either from within the pericardium by pulling the main trunk, which is surrounded by a thread (Fig. 8), gently forward and toward the median line, retracting at the same

[13] Killed ten weeks after operation. Right pulmonary artery firmly closed by ligature. Upper and middle lobe tightly adherent to costal pleura, lower one still free. Pronounced increase of connective tissue in two upper lobes, less in lower (Report by Dr. Fred E. Sondern).

time the superior vena cava outward, or outside of the pericardium through an incision of the pleura, right above the vena azygos (see Fig. 9 with legend). More experimental work must clear up this point.

I would like to mention here a rather strange observation. After ligation of the main branch of the pulmonary artery (left) we had expected a reduced hemorrhage (return blood) on puncturing the blood-vessels that run on either side of the bronchus. This was not so. It bled freely so that we had to ligate. Where did this blood come from? We had beyond doubt securely closed the artery, for the vessel was divided between two ligatures, and when the dog was killed at the end of the experiment by stopping the differential pressure this point was carefully investigated and corroborated. It did not bleed synchronously with the respiration so that we could exclude distention and collapse of the lung being responsible for the phenomenon. It is further hardly conceivable that the small bronchial arteries, though coming directly from the aortic arch, should throw such an amount of blood into the lung as to produce a hemorrhage of such intensity; besides, as far as known, there exists no communication between pulmonary and bronchial arterial system, for obvious reasons, as the one carries venous the other arterial blood. The left lung also did not become so profoundly anæmic in several experiments as did the right lung after intrapericardial ligation (one observation). We had no time to repeat these experiments much to our regret, and did not test the branches of the right pulmonary artery alongside the bronchi, as we wanted our dog to live, if possible. I therefore mention the observation here for what it may be worth. If corroborated, then there must be some kind of collateral circulation in the left lung of the dog. And if the same anatomical condition should exist in man, it would help to explain how patients with partial or rather gradual severe pulmonary embolisms may recover.

In the human being the right heart is situated almost entirely behind the sternum. Trendelenburg's incision trans-

ferred to the right side will not give sufficient approach, not even in the cadaver. Longer incisions too (see Fig. 2, *b* and *c*) were found unsatisfactory. They may allow the operator to reach the right pulmonary artery in the upper part of the pericardium, but will never give him sufficient room in the living for satisfactory control of the deep-seated operating field in case of emergency. Only by means of a trap-door will the right heart and large blood-vessels within the pericardium become so thoroughly exposed that gentle handling and operating on them is rendered possible (see Fig. 2, *d*). The wall of the pulmonary artery and its branches is thin like that of a vein. In the frozen cadaver the Dechamp needle easily penetrates the vessel in the attempt of surrounding it. Dechamp's needle must have, for this work, a special length and special curve, also a very blunt point, in order to avoid hemorrhage. Perhaps it will be best for the operator to surround in the living patient the right pulmonary artery, which at this place is about the size of a man's thumb and flanked on either side with fat, with his right forefinger introduced from below upward. Extreme gentleness and careful, slow, and always blunt advance are absolute requirements. If men react as dogs, no shock will follow the tightening of the ligature. Whether a strong silk suture or a piece of tape or a fascia graft or even a small aluminum clamp should be made use of for closing the vessel only practical experience on the living can decide.

Two main questions arise with regard to this kind of ligation. One of them is: Is the disease sufficiently grave to warrant this intrapericardial ligation of the pulmonary vessels? The other is: Has the surgeon the right to cut off the flow of blood to the non-affected lobes of the lung? The first question can be answered decidedly in the affirmative: it is sufficiently grave. Experience must show whether dangerous reflexes might mar the result of the work in man; possibly an application of a 1 per cent. novocain solution, or even a stronger cocain solution at and around the field of operation, inside the pericardium, may help to overcome this danger.

More difficult is the answer to the second question. In order to render it, the pathologists must tell us whether the upper lobe is really entirely healthy in the majority of these cases. It is surely a fact that they have been found involved. But assuming, for argument's sake, that they are not, that they represent an unaffected part of the lung, then we know from experimental surgery that the sudden dropping out of the work of one entire lung, as in total pneumectomy, is so easily borne by the animals, that on the first day after the operation they bark and move about as vigorously as if nothing had happened. We have, as is well known, an abundance of lung and get along nicely with one lung. Naturally, if both lower lobes are the seat of the disease the peripheric ligation must remain the operation of choice.

Observations have not been carried out sufficiently long, of course, to allow conclusions as to the real value of the ligation of branches of the pulmonary artery in the treatment of bronchiectasis. We must not forget that the bronchial walls, which are the seat of the disease, are nourished by the bronchial arteries and that the pulmonary vessels attend to nothing but to transporting to the lung venous blood for ventilation. If after ligation of the main trunks, prolonged inhalation of superheated air and subsequent collapse therapy by means of thoracoplasty, the disease should not be cured, but the symptoms only alleviated, then this procedure should take second place, and all efforts should be concentrated on the last operative possibility:

E. Pneumectomy. Personally I believe that we shall learn to do this operation also in the human being with less danger than many investigators have attached to its performance. If the vagus reflexes and those from the sympathetic system can be overcome, possibly also with the help of cocain or its derivatives, there is no reason why man should not stand the operation as well as animals, since we have learned how to make the bronchial stump air-tight after amputation of the lung. Efforts of surgeons operating in this field will certainly move in that direction in the near future.

SARCOMA OF THE CHEST WALL.*

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OPERATIONS for tumor of the chest wall have always been among the comparative rarities of surgery.

Tumors of the chest wall, ribs, and sternum may be divided into primary tumors: fibroma, chondroma, sarcoma, and their combinations, and secondary tumors: sarcomata and carcinomata.

The primary tumors are of considerably greater interest. The diagnosis is ordinarily very simple, and reduces itself merely to the existence of the tumor. Pathologically they are chondromata, chondrosarcomata, osteosarcomata, or mixed tumors. The growth is always about the same. They appear almost always at about the middle of the thorax (Molimard). In thirty-nine cases in which the position was accurately indicated the tumor was located only three times on the first rib and six times on the second. They are more apt to be located on the sixth, seventh, and eighth ribs. They appear over the rib on either side, and usually involve the rib above and the rib below. In those thirty-nine cases, Molimard found one rib involved only nine times; two ribs, six times; three involved fifteen times; and seven ribs involved four times. While spreading on to the ribs, the tumor mass ordinarily does not attack the skin or the muscles.

For a long time usually the tumor expands first outside the chest, so that the intercostal vessels and nerves are not affected. Occasionally the growth of the tumor inward is attended by great pain due to involvement of the intercostal nerves. At first the nerves are lifted up, but finally both vessels and nerves are surrounded by the tumor. The tumor does not invade the lymphatics, but extends by direct growth

* Read before the American Surgical Association, May 7, 1913.

along the intercostal space toward the sternum and the posterior end of the ribs. Sometimes the vertebral bodies may be attacked without its being seen on the outside. After expanding for a certain length of time on the outside these tumors extend inward and project into the intercostal space. The pleura over them is thickened at first, and finally invaded by the tumor. The visceral pleura is rarely involved because the tumor does not become adherent and extend over to the lung. The lung, as in the cases reported in this paper, may be deeply indented by the tumor without becoming adherent to the pleura. In rare cases, adhesion of the visceral pleura and invasion of the lung does, however, take place. Numerous authors have reported removal of a portion of the lung in the removal of these tumors, among whom may be mentioned Voutier, Tropinow, Sedillot, Helferich, and others. Nevertheless, the direct invasion of the lung by the tumor even when the lung is adherent is rare. Invasion of the pericardium also is rare, but extensions to the diaphragm are more common.

The dangers attendant upon the opening of the pleura in the early days were very great. Of the very few cases reported in literature in the pre-aseptic period, almost all died. If they survived the hemorrhage and shock of a formidable operation with opening of the pleura, they died of infection; and in the early days of the antiseptic method, they began to die of carbolic acid poisoning. Naturally, tumors of the chest wall were allowed to attain a great size before the danger of an operative attack was thought to be justified, and the mortality of the operative cases was high. The shock of operating upon the chest wall is great in proportion to that in other parts of the body: 1. Because of the interference with respiratory rhythm; 2. The nearness of the heart and great vessels; and 3, and most important, to the fact that when the pleura is widely opened there is interference with respiration and circulation on account of the sudden collapse of the lung. The collapse is due to the altered conditions of

pressure. The mediastinum with its great blood-vessels and nerves is deflected to the opposite side,—less in man than in animals, it is true, but enough to be a cause of severe shock.

If these untoward conditions be overcome, there is the danger of infection in the pleural cavity, especially if, as was usually the case when drainage was employed, the lung was left collapsed at the end of the operation so that the closure of the cavity was impossible, and empyema,—bad enough in any case, but worse still when attacking a patient whose lymphatic spaces had been opened up by an extensive and mutilating operation,—was almost certain to follow.

Asepsis, modern instruments, and improved technic have, however, of late years gradually diminished the dangers of hemorrhage and infection; while during the last fifteen years, the improvements in our method of maintaining the expansion of the lung during the operation by positive pressure, Fell O'Dwyer apparatus, the positive and negative pressure cabinets of Sauerbruch, Brauer, and others, culminating in the almost ideal method of intratracheal anæsthesia, have removed the chief dangers of operative interference. The X-ray has enabled us to make an early diagnosis, and tells us whether we must be prepared for an extensive opening in the pleura or not; so that it is now our own fault if we do not deal with these cases better than did our predecessors.

In 1898, F. W. Parham, of New Orleans, published a most thorough and scholarly report of what had been accomplished from the dawn of time in the surgery of the thoracic wall. He had at that time operated upon two tumors of the thoracic wall requiring extensive opening of the thorax, and was obliged in the first case to combat severe shock which instantly supervened when the thorax was opened. In the second case, he employed the Fell O'Dwyer apparatus for inflation of the lungs, and was enabled to prevent collapse of the lung, dispense with irregular respiration and shock, and at the end of the operation, to suture the lung around the margin of the opening in the chest wall so that it was maintained in expansion. In his most thorough and inclusive

article, Parham reports all the cases of surgery of the chest wall in which the pleura had been opened, published up to the time of his own cases,—only fifty-two in number—and analyzes them from every point of view. The chief point of practical interest was the study of the effects of the pleural opening. A small pleural tear quickly controlled by stopping the opening with gauze or other pads was shown to have produced little shock. The presence of adhesions prevented shock by inhibiting collapse of the lung. The wide opening of the pleura, with the sudden entrance of a large current of air, intensified the shock to an extreme degree. The methods by which this had been controlled had been the covering of the pleural opening by the finger, compresses, or suturing; traction of the lung into the opening, stitching the lung into the opening (Tuffier, Beyer, and Parham); substitution of temporary hydrothorax for pneumothorax (Witzel); injection of sterilized air (Lowson); Quenu and Longuet's intrabronchial tension; O'Dwyer's method, etc. Parham speaks enthusiastically for the Fell O'Dwyer apparatus; yet after his paper was published, various operators (Rixford, Porter, and others) reported cases of tumor of the chest wall successfully performed without special apparatus, in which various rough expedients were adopted to close the opening in the chest. Perhaps this was because the cases were so rare that when they presented themselves few surgeons had the special apparatus at hand.

Then came the important work of Sauerbruch, Brauer, Willy Meyer, Robinson, and others, which provided us with pressure cabinets, the cumbersome nature and expense of which, in proportion to the rarity of the cases in which they were of benefit, precluded their general adoption; and then the intratracheal anæsthesia, which places within the reach of every surgeon a safe and simple apparatus which does everything that the pressure cabinet does and even more safely for the patient. The superior safety of this method lies chiefly in the fact that with the catheter in the larynx and the air current rushing outward around it, neither mucus,

nor blood, nor œdema, nor dropping of the tongue, nor even cessation of the respiratory movements can interfere with the air exchange. The apparatus is useful for so many other conditions beside lung surgery,—neck, tongue, mouth, pharynx, cerebrum, etc.—that it is in almost constant use in large clinics where it is employed at all.

My own excuse for reporting the case which follows is, first, the rarity of these cases; second, the exact pre-operative diagnosis which the X-ray enabled us to make; third, the extreme simplicity of the operation, and the ease with which the lung was kept in expansion with a widely opened thoracic wall; fourth, the fact that I have so far found few reported cases of chest surgery under the intratracheal method in which there were no adhesions, the lung being entirely free; and fifth, that it illustrates the importance of dispensing with drainage in these cases.

S. P., about thirty-three years of age; housework: A tall, delicate, somewhat anæmic woman. Had noticed three years before a tumor under the left arm, which at first was quite small and had recently grown rather fast.

Examination showed that she had hypertrophy of both breasts, and in the right axilla attached to the chest wall was a mass about the size of a baseball. X-ray showed that this mass projected inside the chest (Fig. 1).

At the Corey Hill Hospital, on June 19, 1912, I made a curved incision in the left axilla, starting at the level of the second rib, at the lower border of the latissimus dorsi, carrying it six inches forward on to the breast, then downward about four inches, then backward to a point below the beginning of the incision. On turning this flap backward and dissecting free the pectoralis major and latissimus dorsi from the tumor, I surrounded the tumor, taking great care not to peel the subcutaneous tissue from its surface but leaving it attached. The third, fourth, and fifth ribs were then divided by an osteotome, in front of the tumor, the pleura being widely opened. Then the ribs were divided behind the tumor, and the tumor with about six inches of these ribs removed. The operation was

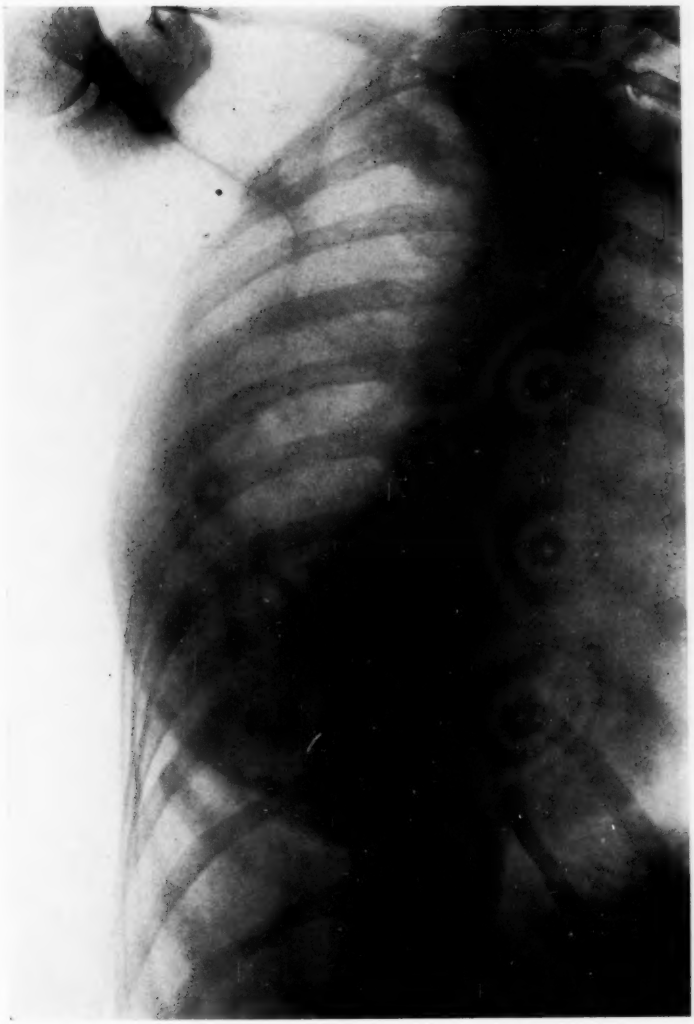
FIG. 1.

X-ray of patient before operation, showing tumor.

FIG. 2.

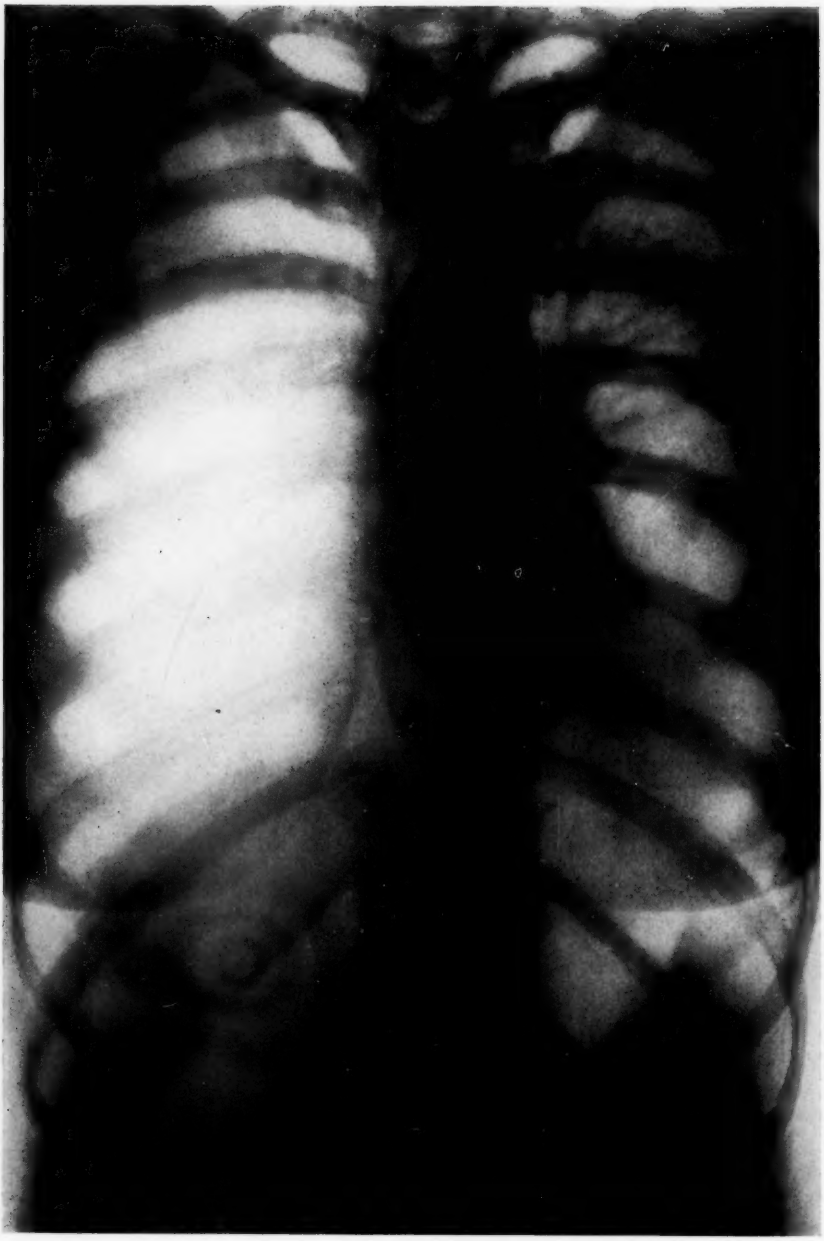
Photograph of patient after operation, showing incision.

FIG. 3.



X-ray of left chest taken October, 1912, four months after operation, showing absence of tumor.

FIG. 4.



X-ray taken April, 1913, showing thickening of the pleura and absence of tumor.

FIG. 5.

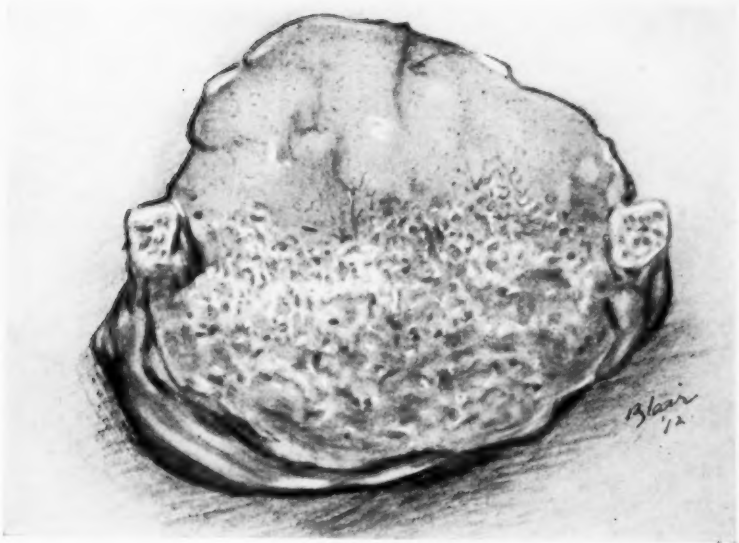
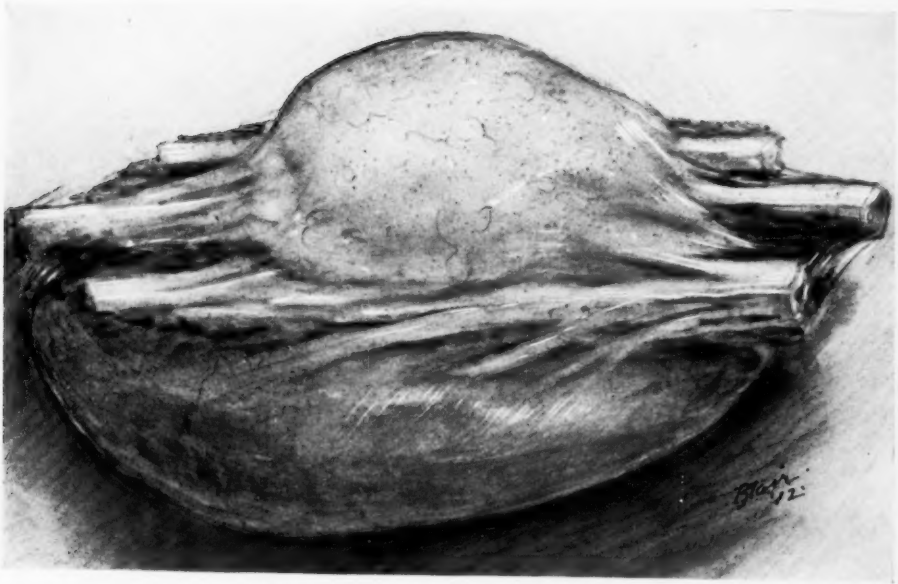


FIG. 6.



FIGS. 5 and 6.—Specimen of sarcoma of ribs.

done under intratracheal anæsthesia, and the lung was kept continually blown up with the bellows until its close. It being then necessary to sponge out some blood which had run into the pleura, the lung was allowed to collapse and the cleansing of the pleura was easily accomplished. There was a good deal of hemorrhage from the muscular tissue. The intercostal arteries were tied and all hemorrhage stopped as far as possible; then, the lung being blown up so as to fill the pleura entirely, the greater pectoral and latissimus dorsi muscles were sewn together across the opening with interrupted sutures of catgut. The skin was then sewn with a Bartlett suture of silkworm gut (Fig. 2).

The patient bore the operation well and was in good condition the next day. On the second day, her breathing became rapid and irregular, and she became somewhat cyanotic. I found some dulness over the lower part of the pleura, tapped the chest, and after removing about nine ounces of blood, the symptoms were relieved.

Two days later, the symptoms returned to a slight extent, and I again tapped the chest, and this time got four ounces. The patient ran a rather rapid pulse, 100 to 120, and a slight temperature for two weeks. This temperature was undoubtedly due to absorption of blood clot.

It is possible that the negative pressure caused by tight suture of the pleura may have at first tended to increase the hemorrhage but I do not believe that this was a serious factor. There was slight dulness over the lower part of the chest and bronchial respiration over the upper part, the upper back, the middle back, and the upper front. The temperature fell to normal at the end of two weeks, and the wound healed by first intention. She went home in three weeks and has since been well. I present an X-ray (Fig. 3) taken in October, 1912; and another one (Fig. 4) taken in April, 1913; showing a slight shadow on the left, probably due to thickening of the pleura, but the entire absence of any signs of tumor, the ends of the ribs showing clean edges where they were cut off (Figs. 5 and 6).

A brief review of the literature since Parham's paper in 1898 shows that twenty-eight cases have been reported.

Among the more interesting communications on tumors of the chest wall is an article by Rixford in the *Transactions of the American Surgical Association,* 1905, volume xxiii, in which he reports four cases of resection of the chest wall for recurrent carcinoma of the breast, and one of sarcoma of the clavicle involving the first rib and sternum. He used a wet towel tucked under the opening in the chest as soon as it was made to occlude it, thus closing the opening and checking the lateral excursions of the lung and mediastinal tissues. The towel was folded on itself two or three times, and slipped beneath the partially loosened section of the chest wall at the moment of complete expiration when the chest was largely emptied of air; and in all the cases there were no untoward symptoms from pneumothorax. No drainage of wounds or pleura.

REHN, *Archiv. für Klinische Chirurgie,* 1906, 81, p. 362, reports three cases of tumors of the chest wall, involving the removal of large portions thereof. He considers the operation dangerous. Campo, he says, has collected reports of 57 cases, of which 11 died as a direct result of the operation. Removal of chest wall tumors when the pleura is not opened is not a serious matter. Opening the pleura is in itself serious, and only one recovery is reported in literature where both pleuræ were opened: that of Franz König. Rehn advocates suture of the lung to the pleura with a large curved needle before opening the latter; and as soon as the pleura is opened, drawing the lung out with the hand by means of warm, moist compresses. At the close of the operation, he sutures the lung to the chest wall, and closes the skin without drainage.

DOLLINGER produced pneumothorax by making a cut into the pleura several days before the removal of a tumor of the chest wall, so that it may not be immediately produced at the time of the operation.

SAUERBRUCH reports two cases of resection of wall of thorax for carcinoma of mamma; one was adherent, one a recurrence after removal of a breast cancer. In the first case, the breast and infiltrated soft spots were removed with resection of two ribs. A flap of skin from the side was laid upon the lung with no distortion, and healed normally in place. The flap was the size of the palm.

In the second case, three ribs were removed, with soft parts, leaving an area thirty centimetres long by twenty-one centimetres wide, and pleura also to this whole extent. No pleural adhesions, and sound lung. The large area was covered by a flap from the side and transplantation of the opposite breast. Good recovery of patient and gain in weight.

C. B. LOCKWOOD, in *The Clinical Journal,* September 25, 1907, reports

two cases of tumor of the chest wall, one a carcinoma following carcinoma of the breast. The patient with carcinoma of the chest wall, in which several pieces of several ribs had to be removed and the pleura opened widely, recovered and was well for a year. The second case was one of spindle-celled sarcoma of the chest in a girl of seventeen years. Portions of the fifth, sixth, seventh, and eighth costal cartilages were removed. The diaphragm was infiltrated and the peritoneal cavity opened, and the apex of the pericardium also removed. There was some shock at the time the pericardium was opened. A portion of the lower lobe of the left lung was removed. Hemorrhage from the lung was stopped by a cautery. After removal of the tumor and closing of the opening in the peritoneum and pericardium, the thoracic wound was closed without drainage. There was very severe shock. The patient rallied, recovered, and was well six months afterward.

W. O. ROBERTS, *Louisville Journal of Medicine and Surgery*, January, 1906, speaks of thoracic resection for tumor growing from the bony wall of the chest. Found a small tumor, and the rib from which it was growing was removed.

Other cases reported in the literature will be found in the following table. On looking these over, it will be seen that as far as the table goes, there is little difference in the above as to whether Sauerbruch's cabinet was used, or the pressure apparatus, or simply closing the pleura with compresses. It will be found, for instance, that there were 28 cases reported, of which 26 recovered and only 2 died,—a very small mortality; that in only 3 of the cases was either the Sauerbruch cabinet or positive pressure employed; closure of the opening by compresses or traction on the lung was employed in 11 cases; shock was present in 9 cases, absent in 13, and not mentioned in 6. Murphy's positive pressure apparatus was employed in one case.

These are all the cases that I have been able to collect since the publication of Parham's paper in 1898.

As far as one can tell, the sudden wide opening of the pleura tended to produce shock, and the opening of the diaphragm produced shock whether positive pressure apparatus was or was not used. I think there is no doubt, however, entirely irrespective of statistics, that in cases of equal severity those operated upon with positive or negative pressure would do better than the same cases operated upon with-

ABSTRACTS OF REPORTED OPERATIONS FOR SARCOMA OF CHEST WALL.

Name and Date.	Operation.	Method contra Pneumothorax.	Shock.	Result.
Webber (*Lancet*, 1900, ii, p. 1347).	Removal of sixth left rib with tumor. Left pleura and pericardium freely opened. Left lung collapsed.	Not mentioned.	Not mentioned.	Recovery in spite of bronchitis.
LeDentu (*Bull. et Mem. de Soc. de Chir. de Par.*, 1902, 28, p. 244).	Removal of parts of 3 ribs for chondrofibroma with small portion of diaphragm.	Traction on lung. Pleura opened freely and as late as possible. Drainage of pleura. Suture of lung to skin flap.	Marked on opening pleura.	Double pneumonia followed, which still existed at date of report, 2½ months after operation.
Griffith (*Lancet*, 1902, ii, p. 991).	Resection of sternum from 2d to 7th costal cartilages. Left pleural cavity opened. Growth (sarcoma) not completely removed.	None. Pleural opening could not quite be closed by sutures.	Slight.....	Recovery from operation. Death 4 mo. after.
Delorme and Piollet (*Lyon Med.*, 1902).	M.30. Tumor attached to 7th, 8th, and 9th ribs. Removed. Pleura widely opened. Lung retracted deeply. Small gauze drain in pleura.	No apparatus..	No shock.....	Recovery.
Israel(*Berl.klin. Woch.*, Mar., 1903, No. 22).	Removal of a tumor of the body of the 6th dorsal vertebra. Small opening of pleura was made.	Opening stopped up with gauze packing.	No shock.....	Recovery.
Reeve (ANNALS OF SURGERY, 1903, 37, p. 724).	Resection of 3 ribs on right for tumor. Opening in pleura size of 2 hands. Diaphragm injured but not opened.	Not stated....	No shock.....	Recovery.
Rixford (1905. *Transactions, Am. Surg. Assoc.*, vol. xxiii).	Four cases: 3 of carcinoma of chest wall secondary to breast carcinoma. One sarcoma of clavicle involving 1st rib and sternum.	Hot, wet towel tucked under edges of opening so as to close it as far as possible.	Not present on opening pleura.	All recovered.
Deruginsky (*Am. Surg.*, 1906).	1st: removal of parts of 8th and 9th left ribs. 2d: removal of all left thoracic wall from 7th to 11th ribs with a portion of diaphragm.	Gauze tampon. Gauze tampon.	Did not ensue upon opening pleura.	Recovery.
Torek (*Post Graduate*, N. Y., 1906, p. 335).	Removal of 4th, 5th, 6th, and 7th ribs for sarcoma, with portion of lung. Numerous metastases in pleura and lung.	None.....	Severe.....	Death from shock.
Rehn (*Archiv. klin. Chir.*, 1906, 81, p. 362).	1. Removal of portions of 3rd, 4th, 5th, and 6th ribs for recurrence after carcinoma of the breast. 2. Removal of 12 cm. of 4th and 5th ribs, (Right) for sarcoma.	Lung drawn out and sutured to chest wall. Lung drawn out and sutured to opening in chest wall.	None..... None.....	Recovery and long freedom from relapse. Recurrence. Death from secondary operation, 3 months later.

ABSTRACTS OF REPORTED OPERATIONS FOR SARCOMA OF CHEST WALL—Cont'd.

Name and Date.	Operation.	Method contra Pneumothorax.	Shock.	Result.
Rehn (*Archiv. klin. Chir.*, 1906, 81. p. 362).	3. Removal of a sarcoma of the size of the fist with the 2d and 3d ribs on the right.	Lung drawn out and sutured to opening in chest.	None.....	Recovery. No recurrence in a year.
Roberts, W. O. (*Louisville Jour. of Med. and Surg.* Jan. 1906).	Removal of a tumor of the chest wall with attached rib.			
Lockwood, C.B. (*Am. Jour.*, Sept., 1907).	1. Carcinoma recurrent after breast carcinoma.	Nothing done to prevent pneumothorax.	Very severe...	Recovered and was well 6 months afterwards.
	2. Spindle-celled sarcoma in girl of 17. Two portions of 5th, 6th, 7th, and 8th cartilages were removed. Diaphragm was opened, and apex of pericardium removed. Some shock when pericardium was opened. Portion of lower lobe of left lung removed. Hemorrhage from lung stopped by cautery.	Nothing done to prevent pneumothorax.		
Hoffman (*Beiträge z. klin. Chir.*, 1908, p. 182). Operation by Kuttner.	Removal of sarcoma of 5th, 6th, 7th, and 8th ribs, with spontaneous fracture of the 5th rib, from an 18 year old girl.	Sauerbruch cabinet.	None.....	Recovery.
Molimard (*Faculté de Med. et Phar. de Lyon*, Tome, 9, 1908). Operator, Poncet.	M. 18, Sarcoma of 7th, 8th, and 9th ribs. Diaphragm injured and closed by suture.	No apparatus..	Not stated....	Recovery.
Porter (*Boston Med. and Surg. Jour.*, Dec. 24, 1908).	Enchondroma of 6th, 7th, 8th, and 9th ribs; removed with injury to and suture of diaphragm. Lung sutured to intercostal muscles at close to prevent retraction.	Dr. F. T. Murphy's positive pressure box.	None on opening pleura.	Death, pneumonia, 14th day.
Hoffman (*Beiträge z. klin. Chir.*, 1908, p. 182). Operation by Kuttner.	Resection of two ribs for recurrent carcinoma.	Sauerbruch cabinet.	None.....	Recovery.
Menistrina, J. F. (*Med. Fortnightly*, St. Louis, 1909).	M. 55. 6th, 7th, 8th, and 9th ribs removed for sarcoma.	Pleural cavity opened slowly and packed off with gauze.	Slight.....	Recovery.
Huguier and Rigollot-Simonnot, Paris, 2, 1910.	M. 52. Chondroma of chest wall, involving 7th, and 8th ribs which were removed with it. Resection of a portion of the diaphragm.	Pleura opened slowly. Lung sutured to ribs.	None.....	Recovery. Chest had to be tapped twice to remove blood.
Pier (*Deutsche med. Woch.*, 1911, No. 24).	M. 15. Removal of carcinoma involving 3 ribs, and resection of a portion of diaphragm.	Brauer's positive pressure cabinet.	Severe, but checked when opening in diaphragm was sutured.	Recovery.

out special apparatus; and also that the same cases operated upon under intratracheal anæsthesia would do still better than in the cabinets, and at vastly less expense and trouble. I feel, indeed, that we can hardly better express the contributions of the intratracheal addition to thoracic surgery than in the words of Gosset: "La peur du pneumothorax ira retrouver la crainte du peritoine."

I wish to acknowledge my indebtedness to Dr. Samuel Robinson for his kindness in letting me see his cases in consultation and for furnishing me with references to literature.

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ACUTE PERFORATING SIGMOIDITIS IN CHILDREN.*

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ALTHOUGH our knowledge of acute and chronic inflammations of the sigmoid as distinct surgical entities dates back less than twenty years, case reports have been so numerous that to present another to the association would be without justification, unless it presented some unusual features. In nearly all cases, at least in adults, the immediate cause of the acute inflammation is an obstructed diverticulum which shows *a priori* that an acute process has been grafted on a chronic one. In the majority of cases the chronic process which leads to diverticulation does not make itself manifest, until obstructive symptoms arise or until a gross perforation or a pericolic infection through a still unbroken but permeable wall takes place. How innocuous a chronic diverticulitis may seem is shown by the case of Brewer [1] in which two operations, six years apart, were performed on a patient who seemed perfectly well in the interval. This latency of a condition potential of great disaster is a not unimportant one of the many points of analogy between inflammatory conditions of the two lower abdominal quadrants. That an analogy, one might almost say an identity, of the sequences of the pathologic processes in the appendix and the sigmoid diverticulitis exists may be assumed as absolute, although according to Powers [2] hardly more than a dozen cases of acute diverticulitis operatively treated have been reported.

In a negative way the analogy might be continued, for as suppurations in the right lower quadrant may originate in the intestine independently of the appendix, so I take it that in more frequent instances will suppuration about the sigmoid

* Read before the American Surgical Association, May 8, 1913.

colon develop without a diverticulum as the primary cause. All the reported cases of diverticulitis which I have been enabled to examine have been in adults, mostly in males in mid-life and given to obesity. It is almost impossible to conceive of an acquired diverticulum in a child, wherefore, I have designated the following case one of perforating sigmoiditis.

CASE I.—R. H., aged three years, male. Was admitted to Jewish Hospital at 8 P.M., October 22, 1912. During seven days before his admission he had been under the observation of Dr. Bird, of Greensburg, Ind., to whom I am indebted for the following history. While in the hospital Dr. Rachford was consultant.

Family History.—Father had tuberculosis of knee, mother had tuberculous glands of the neck up to her fifteenth year. Two older children had always been well. The child had always been well save for a marked tendency to constipation.

The present illness began as a slight indisposition with loss of appetite and marked constipation. This was attributed by the mother to her failure to pasteurize the milk as had been her custom up to the onset of the present illness. The evening temperature was 100 and pulse rate between 90 and 100. Constipation was the marked symptom. The exhibition of castor oil and saturated solutions of magnesium sulphate together with high enemata failed to effect. The highest temperature recorded up to the fourth day was 101. Satisfactory examination of the abdomen could not be made since any effort to make it brought forth violent crying spells. On the fourth day alboline was given in dram and later in half tablespoonful doses. This seemed effective for on the fifth day a small stool from the upper bowel was passed and contained a small quantity of alboline. A second stool containing a free admixture of alboline was passed. Altogether eleven ounces of alboline had been given. On the sixth day there developed a very sharp attack of abdominal pain, which lasted more than an hour. This was followed by accesses of vomiting. There also developed a marked distention of the abdomen and the temperature rose to 103. There were no further stools, nor was there discharge of any kind from the rectum.

Condition on Admission.—The patient presented the general appearance of suffering. He frequently cried out with pain. The temperature is 101.8, pulse 132. Abdomen is distended. The costal arches cannot be seen. On percussion there is general tympany with liver dulness somewhat pushed up. Although there is general muscular rigidity no special tenderness can be elicited. The examination is very unsatisfactory by reason of the child's resisting. Urinalysis negative.

Blood Examination.—White 15,800—polymorph. 53.11, small mononuclears 26.09, large mononuclears 20.09, eosinophiles 0.71.

An X-ray picture taken after the ingestion of a bismuth meal shows no intestinal occlusion, but a general gaseous distention. Digital examination of the rectum indicates some resistance on the left side of the pelvis, but it is not very distinct. Within the next two days the patient's condition did not improve. There was occasional vomiting of biliary matter, but no stool was passed. The blood count, October 23, was only 11,800 white. On October 24 it had risen to 22,000 and on the morning of the 25th to 33,000. At this time the rectal examination showed a distinct infiltration on the left side of the pelvis. It was then only that consent for an operation was obtained.

Provisional Diagnosis.—Appendicitis with left sided pelvic abscess.

Operation.—Jewish Hospital, October 25, 1912. Gas oxygen anæsthesia. When relaxation was obtained a very decided induration was observed for the first time in the left lower quadrant, wherefore, a pararectal incision was made on the left side.

On opening the peritoneum a slight amount of clear fluid escaped. The intestines were moderately distended. A mass on the left side contained the sigmoid with adherent overlying omentum. The latter was gently separated from the underlying intestine, whereby an abscess containing two or three ounces of very fetid pus was opened. The greater part of the purulent accumulation came from the left side of the pelvis. On widely retracting the wound margins and gently separating the omentum the entire sigmoid was exposed. For about three inches the walls were very much reddened, thickened and indurated. The entire mass was fixed on the iliac pan. The tineæ could not be made out, but a number of appendices were exposed. Except

for these the surface of the sigmoid was uniform. There was no evidence of diverticulation. At the summit of the sigmoid loop there was a necrotic area as large as the little finger nail, which extended deeply into the intestinal wall. No effort was made, of course, to see whether it communicated with the intestinal lumen, although it seemed evident that rupture was imminent. The area was inverted, fixed with a few Lembert sutures and covered with omentum. The operation was completed by the insertion of a deep-seated cigarette drain. The post-operative course was rather a stormy one. Two days after the operation there were two bloody stools. The leucocytosis gradually subsided and with it the temperature. The latter, however, did not reach normal until the eleventh day. The patient left the hospital on the twenty-first day in practically normal condition.

A second case of suppurating perisigmoiditis in an infant was referred to me by Dr. Rachford.

CASE II.—The patient, a female of nine months, had for several months suffered on and off from enterocolitis. It was a bottle-fed child. When brought to this city from its home in Lafayette, the patient was greatly emaciated and had evening temperature of 102. The stools frequent and small were occasionally blood-stained and there was always great rectal tenesmus. There had been no vomiting. The abdomen was slightly distended and in the lower left quadrant an indistinct swelling as large as a peach could be mapped out. It was very tender and seemingly fluctuating.

Operation.—Good Samaritan Annex, December 1, 1903, under chloroform anæsthesia, revealed no peritoneal involvement, but an abscess in the sigmoid-mesocolon. About three ounces of not fetid pus escaped. The abscess being well walled off the sigmoid was not looked for. Drainage was instituted and the patient made a slow but complete recovery.

The first of the above cases seems unique to me, for after a rather complete investigation of the literature of sigmoiditis I have found no similar case.[a] Giffin,[3] in a report of twenty-

[a] Since the above was written, I have come across a case reported by Goebel in a boy of three years in whom a secondary resection of the sigmoid loop was successfully made (Zentralbl. f. Chir., 1911, p. 211).

seven chronic cases, places the average age of diverticulitis at a little less than fifty-four years. Of one hundred and five cases of intestinal diverticulum cited by Telling[4] there was only one under forty years old. Hartwell,[5] it is true, conceded three cases occurring at the ages of seven years, six years and ten years respectively. The last two cases were obtained by autopsy. The diverticula were congenital and had nothing to do with the cause of death.

In the first case reported by Ashhurst,[6] the patient was operated upon and a mass found in the mesosigmoid. Ashhurst, himself, is in doubt as to the existence of a diverticulum in the mesenteric attachment of the gut as the primary cause of the swelling in the mesosigmoid. Therefore, he concedes that his diagnosis of mesosigmoiditis is conjectural. Another case of suppurating diverticulitis in a child which is often quoted is that of Walcha.[7] The patient, a ten-year-old girl, had passed a round worm two days before the onset of the symptoms. An abscess formed on the left side of the abdomen and the child died on the sixth day, evidently from peritonitis. There was no autopsy and there is no reason for believing that this was a case of diverticulitis.

It is probable that in the second case above reported we had to deal with a lymphangitis, which resulted in abscess from infection through an intact intestinal wall or a lymphadenitis from the same cause. When one considers the wealth of lymphatics in the intestinal wall and the frequency of infections of the intestinal mucosa, it is really remarkable that intramesenteric suppurations (of the nature of the case reported) are not more common.

If we except the doubtful case of Ashhurst as the only one operated on for diverticulitis in a child, there is no recorded case. In the two cases of sigmoid diverticulum discovered by autopsy in children by Hartwell, there were no clinical evidences of the condition. In an examination of five infants who had died from various infantile diseases Hartwell and Cecil found that in three there was some evidence of a weakness at one or more points. In each of the positive

cases there occurred a slight outpushing of the wall of the intestine, which had somewhat the macroscopic appearance of the small diverticula seen in adults.

The examinations were made after the colons had been moderately hardened in formalin and then filled with water just sufficient to render the walls taut but not under enough pressure to stretch them.

These experiments appear to me inconclusive in view of the fact that no demonstrated case of acute diverticulitis in infancy or childhood has, to my knowledge, been recorded. Diverticula, it is true, may be almost microscopic and it is of course possible that such a diverticulum might have been the predisposing cause of the acuter symptoms which necessitated operation in Case I. In a very comprehensive and analytical article by Patel[8] he states, " Perhaps some day we will be enabled to state that almost all the cases described under the name of sigmoiditis are cases of diverticulitis, precisely as appendicitis little by little has been substituted for typhlitis." This inference does not seem to be justified for the one perhaps important reason, namely, that on the right side we *always* have the appendix and that on the left side the presence of a diverticulum can only be assumed until its presence is actually demonstrated by operation or autopsy.

The first case above reported seems to me conclusive that a primary inflammation may develop in the mucosa of the sigmoid, invade the deeper layers of the gut, and lead to necrosis and abscess formation without gross diverticulation as the basal factor.

In the second case there was no certainty even of the involvement of the sigmoid, although the previous history indicated some form of colic infection. In the classification of inflammatory lesions about the sigmoid based on an analysis of seventy cases, Patel classifies seventeen of them under the caption of non-suppurative sigmoiditis. All the cases recovered without operation, so that no evidence was obtained as to the exact anatomic changes which caused the tumor mass as one of the clinical symptoms. Most of these cases occurred

in young subjects and only two of them were over forty. This is in marked contrast with the age history of acute or, for that matter, chronic diverticulitis which come to either operation or autopsy. The findings at operation in Case I so far as the induration, infiltration and fixation of the sigmoid are concerned were very much like those encountered in the case recently reported by Dowd.[9] Here, however, the inflammation involved the descending colon from the splenic flexure quite to the sigmoid. It was found to be red and hard and the walls so thickened that it seemed almost a solid mass and the consistency was nearer that of a garden hose than that of the normal intestine. The microscopic examination revealed great œdema with polynuclear cell infiltration of the mucosa with purulent exudate replacing the mucosa in most places. Had it been possible in Case I to obtain a section of the thickened sigmoid, I am quite certain that the picture would have been the counterpart of Dowd's case.

That sigmoiditis is a clearly defined morbid entity has been established since the articles published for Mayor,[10] Matthews,[11] Rosenheim[12] and Durant[13] in 1893, 1902, 1904, and 1911 respectively. The important factor of the diverticulum, of which the significance was later recognized, has threatened to overshadow the sigmoiditis unassociated therewith. Of course, the acute process when limited to the mucosa is often but a part of a colic infection of the sigmoid, but by reason of the position and function of the sigmoid, manifests itself there with greater severity. It may be necessary only to recall that here the fecal contents stagnate before their final expulsion and the time and opportunity for infection are perhaps greater than anywhere else, with the exception of the cæcum. That the effect in the long run is more baneful to the sigmoid is amply shown by the foreshadowing preponderance in the sigmoid of the chronic diverticulitis with its well-established train of symptoms.

Although two cases of left-sided lower quadrant intra-abdominal suppuration in children are scarcely enough to be statistically valuable, when considered with the hitherto pub-

lished cases in adults, I think they justify me in tentatively submitting the following conclusions.

1. Although few cases of sigmoid diverticulation have been found in children, no case of diverticulitis has been recorded in a child.

2. To designate in a general way, as is the present tendency, all left-sided lower quadrant suppurations as of diverticular origin is not warranted by the facts. Unless a diverticulum is shown, the diagnosis must be problematical. This applies, of course, very much more to children than to adults in whom all the recorded cases have occurred.

3. Left-sided appendicitis cases have been described with and without visceral transposition.

4. It has not been my object to underrate the importance of the sigmoid diverticulum as the cause of left-sided abdominal suppurations, but to call attention to other conditions notably of the mucosa producing them and particularly in children.

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ON EXCISION OF THE INFARCT IN ACUTE HÆMATOGENOUS INFECTIONS OF THE KIDNEY.*

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In recent years considerable attention has been directed to the study of acute hæmatogenous infection of the kidneys: The lesions which have been found are frequently unilateral, fairly characteristic, but by no means uniform in character or extent. Congestion, more or less intense and extensive, with œdema of the perirenal fat, infarctions, red and white, single and multiple, have all been described, singly or in combination. Brewer, who reported his first case in 1904, and later wrote extensively on the subject, has been a pioneer in calling the attention of the profession to the comparative frequency of its occurrence, as well as to the necessity of early diagnosis and radical surgery in the more severe cases.

A study of Brewer's cases, in his paper of 1906, most of which were of the severe septic type, with multiple scattered abscesses throughout the cortex, and with a clinical picture of profound sepsis, will show the wisdom of radical measures, viz: nephrectomy, in this variety.

The reports of Farrar Cobb, 1908, and later of Cotton, 1911, call attention to milder types of infection and the results from conservative measures.

A study of two very unusual cases of my own, which form the basis of this brief paper, reveals a type of acute unilateral septic infarct of the kidney wherein the lesions are discrete rather than scattered, and limited in both instances, to the upper pole and portion of the right and left kidney respectively.

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* Read before the American Surgical Association, May 8, 1913.

The diagnosis in these cases from the urinary findings was quite impossible, and the differential diagnosis in one of them from an empyema, was not easy.

In a fairly large experience in the surgery of the kidney I do not recall having met with a single instance of pathological conditions which resembled very closely the findings of the cases herein reported, nor at the time of operation was I cognizant of the fact that excision of the infarct had ever been attempted, and only learned of Woolsey's case in conversation with him long after my own experience.

In presenting these cases, I have no wish to submit any brief for the performance of this somewhat unique procedure of excision, but simply to present the facts of the cases in point and express the belief that in a somewhat restricted field, perhaps, the operation has a distinct place in that it is reasonably safe and fulfils the indications most admirably.

REPORT OF CASES.

CASE I.—Louis K., twenty-three, single, admitted to the Greenwich Hospital, Feb. 21, 1909, to the service of Dr. Hyde, to whom I am indebted for the report and for much valuable assistance. His previous and personal history were entirely negligible as regards the present illness, which began three weeks ago with a sudden attack of pain in the right side which became worse and necessitated the calling in of a physician, who made a tentative diagnosis of appendicitis and gave him some medicine which relieved his pain. He suffered considerably from dysuria, however, which became worse, and finally, three days before he came to the hospital, complete retention of urine occurred, for which catheterization had been systematically done.

On admission his chief complaint was pain in the right side, and inability to pass his urine. His general condition was fairly good and he did not seem to be very sick. His temperature was 99.2°, pulse, 80, and he showed a white blood count of 12,000. The abdomen was scaphoid, tender over the bladder but no tenderness was noticed at this time, over the region of the kidney. There was a slight urethral discharge, thought to be

due to use of the catheter, as he denied all venereal disease, and the smears were negative. A provisional diagnosis of acute cystitis, with a non-specific urethritis was made, and treatment with hot stupes locally and urotropin and catheterization, was instituted. An examination of the urine at this time showed a specific gravity of 1022, acid reaction, a trace of albumen, and many white and red blood and pus cells. Albumen was never demonstrated in any of the later specimens which were frequently examined, and the rest of the microscopic picture remained about the same, with the pus cells steadily diminishing as the cystitis improved. An examination of the urine for tubercle bacilli was negative.

For the first week, under regular catheterization, and irrigation of the bladder, with boric acid solution and argyrol, he improved steadily and began to void his urine naturally though with some pain.

On March 1 he complained of pain in the region of the right kidney which was increased on deep inspiration and was accompanied by tenderness along the lower right costal margin. This tenderness was most marked over the region of the gall-bladder, but there was no muscle spasm in this situation. There were no signs of pneumonia.

On March 8 as his temperature, which had been moderate, had suddenly shot up to 104.4° the day previous, and his white blood count had risen to about 14,000, with a polynuclear percentage of 80 per cent., I was asked to see him in consultation with Dr. Hyde, who had made a tentative diagnosis of kidney infection. At this time the tenderness over the bladder had entirely disappeared but there was extreme tenderness over the right kidney and extending forward to the middle line of the abdomen. As the case seemed to be one of probable renal suppuration and his condition was getting worse daily, an operation was advised.

Operation (March 12, 1909).—(Dr. Hotchkiss, with the assistance of Dr. Hyde and staff.) An oblique right lumbar incision exposed the kidney which was found to be adherent by its upper pole to the under surface of the right lobe of the liver, and when the somewhat dense adhesions were broken down, a perirenal abscess was opened in this situation which contained a moderate amount of pus, and was well encapsulated.

The kidney having been freed, it was pulled out of the wound and thoroughly examined. The cortex was split longitudinally and an abscess in the upper pole was opened and drained. There was found also a considerable triangular area of soft white infarction, apparently riddled with minute abscesses, and measuring about two inches across its base and not extending into the pelvis. As the rest of the organ appeared reasonably normal and the infarcted portion of the cortex was easily enucleable with the finger, the infarct which was not very adherent, was neatly extirpated in this manner with but very trifling bleeding, and the walls of the triangular gap in the kidney looked to be covered with granulations. The kidney was returned to its pocket and the gap in the cortex was pressed together by gauze pads introduced above and below the organ. These also provided for abundant drainage of the kidney and the wound, which was loosely closed to the drains.

There was free drainage of bloody fluid with a marked urinous odor for several days and the pads of gauze were removed and replaced by smaller ones on the fifth day. No blood appeared in the urine after the operation. About five days later, the gauze was removed and rubber tube drainage instituted, which had to be retained rather long on account of pus retention in the upper pocket following attempts at early removal. By April 13, however, the tubes were all removed, the wound was nearly closed and the patient sitting up and growing stronger daily. On April 30 he was discharged with a normal temperature, his wound healed, and apparently well.

Case II.—Peter K., twenty-three, car cleaner, Austrian, admitted to First Medical Division of Bellevue Hospital, service of Dr. Draper, Dec. 25, 1911. His family and personal history were negative. Married. No children. Denies syphilis and gonorrhœa.

Present illness began three weeks before admission with a sudden attack of pain, sharp and stabbing in character in the left side and only felt on deep inspiration and on coughing. Since onset the pain has been variable, at times almost none, sometimes very severe. One week before, his chest was strapped which relieved him very much. His appetite is poor, he sleeps fairly well, his bowels are regular.

Chief complaint, sharp pain in the left axilla. On examination, he did not appear to be acutely sick. His chest showed fairly good expansion, respirations were normal. There were a few fine râles at the extreme right base, and a few pleuritic râles at the base of the left axilla. Pulse regular and normal as to rate and force. The heart is negative. Abdomen, also negative.

Provisional diagnosis, pleurisy. Temperature on admission, 101°; pulse, 90; respirations, 24. Urine, cloudy, amber, 1029, alkaline, negative as to albumen, blood, bile, casts, pus, indican, and acetone, triple phosphates present. Aspiration of the chest on the day following, yielded no fluid.

Dec. 27: Temperature 102°; pulse 98; respirations 24; Widal, negative; white blood count 26,000; polynuclears 91 per cent.

Dec. 28: Sibilant and sonorous breathing and many fine râles at the left base. Aspiration at base of left lung, yields few drops of pus—a smear from which shows cocci; temperature 100.4° to 103.4°; pulse 72 to 90; respirations 22; white blood count 31,400; polynuclears 93 per cent.

Dec. 30: Temperature 100.6° to 104.6°; pulse 78 to 90; respirations 24; white blood count 26,400; polynuclears 90 per cent.

Dec. 31: Signs of fluid at the base of left lung, more marked, and pus found on aspiration.

January 18, 1912: Left chest aspirated between the eleventh and twelfth ribs, and 3 inches from spine, and 2 c.c. of fluid pus obtained.

Urinalysis.—Amber, slightly turbid, 1029, faintly alkaline, faint trace of albumen, occasional white blood cells and triple phosphates. Temperature 102°; pulse 100; respirations 24. Transferred to surgical side as case of empyema of lower left chest for operation.

In view of the history, the site at which pus had been obtained by aspiration, between the eleventh and twelfth ribs, a diagnosis of abscess below the diaphragm in relation with the left kidney was made by the writer.

Operation.—A vertical incision dividing the twelfth rib and prolonged downward over the left kidney was made and a small abscess was found below the diaphragm in close relation with

the upper pole of the left kidney. The kidney was then pulled into the wound and examined. There was a good sized white infarct in the upper pole of the organ, which was riddled with small abscesses. Having in mind my former experience, and as the rest of the organ appeared uninvolved, the whole area including the infarct was easily enucleated with the finger and without any considerable bleeding as the walls of the gap in the kidney appeared to be granulating, and healthy. Two catgut sutures were introduced, bringing the sides of the gap loosely together. The kidney was dropped back into its bed and gauze drainage introduced and the wound partly closed.

Pathological report on the specimen of kidney tissue: "Large white infarct with small multiple abscesses."

Patient rallied well from the operation, saline given per rectum and on the morning following, five and one-half ounces of urine were voided. This was of brick red color, cloudy, and contained fine granular casts and many white and red blood cells. During the twenty-four hours 37 ounces were passed. Temperature, 100° to 102°; pulse 120; respirations 24.

January 4, 1912: Considerable discharge of bloody fluid from the wound.

January 10: Drains removed from the wound and replaced by smaller drains.

January 14: Wound is slowly granulating, but a small pocket below the diaphragm still discharges pus. Condition good, temperature falling below 100° in the morning, and convalescence well established.

January 28: The patient has been out of bed for past two days and is rapidly gaining. There is still some drainage from the small pocket beneath the diaphragm and the temperature has reached normal. The subsequent history is one of steady progress and recovery and discharge from the hospital in good condition on February 19, 1912.

THE TECHNIC OF NEPHRO-, PYELO- AND URETEROLITHOTOMY.

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I WAS first inclined to bring this subject before the Association because of my own interest in it but was later confirmed in my intention by discovering that only twice in the history of the Association have the different methods of removing stones from the kidney and ureter been a subject of consideration. It was in 1880, the year the American Surgical Association was founded, that Henry Morris first performed deliberately the removal of a stone from an otherwise healthy kidney. In 1895 there were three papers bearing on the subject read at the meeting in New York, that by Fenger on the "Surgery of the Ureter" being perhaps the most complete and satisfactory discussion that has ever been presented anywhere. The early work of Fenger and Cabot in renal and ureteral surgery must ever be a matter of pride with us. Again, in 1908, there were three papers presented (Bevan, McCosh, and Brewer) which produced a general discussion on renal surgery. At this time there was no unanimity of opinion regarding the best method of removing stones from the upper urinary tract but I believe to-day, in the light of improved diagnostic measures, satisfactory functional tests, perfected technic and greater experience, we may expect to find that there is a greater uniformity in our practice.

Nephrolithotomy and Pyelonephrotomy.—The life of nephrolithotomy corresponds to that of this Association as I have said, but for a number of years its tenure was a very doubtful one. As late as 1893, Ashhurst (*Principals and Practice of Surgery,* 1893), summarized the subject as follows: "The operation appears to have been performed in

130 cases, 12 times without finding any stone, and 30 times with a fatal result, while the issue in 5 cases has not been ascertained, leaving only 83 successes. Henry Morris is generally credited with and claims the first performance of this operation, though Ashhurst says "The first formal nephrotomy for the removal of renal calculus appears to have been performed by Marchetti, in the latter part of the seventeenth century." This however, if the case, does not detract from the credit due to Morris for his masterly work in this field and particularly for his earnest advocacy of nephrolithotomy before the kidney has been converted into a pus pocket.

The incision for the exposure of the kidney will probably never become uniform, nor is it necessary that it should. The straight incision along the edge of the erector spinæ with oblique extension along the iliac crest is the most generally employed. The upper portion of this incision near the twelfth rib must be made cautiously in order to avoid injury of the pleura which sometimes extends below the rib. Resection of the rib, especially when exposing the left kidney, makes the operation easier but I have never found it necessary. Mayo (ANNALS OF SURGERY, 1912, vol. lv) advises the free exposure of the twelfth rib and the division of the quadratus and the lateral arcuate ligament which bind the rib to the transverse process of the first lumbar vertebra and says that this procedure obviates the necessity of rib resection. I have lately followed this plan and find that it renders exposure and delivery of the kidney much easier. The injury of the pleura is not a serious one if promptly repaired. A more serious mistake is the division of and failure to suture the iliohypogastric and ilioinguinal nerves. These nerves should be exposed and drawn out of the way. Having opened up the fatty capsule and exposed the kidney, the hand should be introduced and the kidney and the upper ureter carefully palpated for stone. This should be done before the delivery of the kidney, as in the latter procedure the manipulations may cause a stone to be displaced and forced into the ureter. I believe that palpation is the best means we have for finding

the stone. When carefully carried out I think it will demonstrate nearly any stone. Needling is a most unsatisfactory procedure and I think a dangerous one. I have removed a stone which needling failed to locate at a previous operation. If palpation fails to reveal a stone which is shown in an X-ray plate, the kidney or its pelvis should be opened and palpation carried out from within the organ. If the X-ray fails to show a stone and if palpation does not reveal it, I should not feel justified in opening up the kidney or the pelvis, unless I thought the symptoms were caused by some other condition which the further exploration might expose. A good X-ray plate of the entire urinary tract is essential to-day in the search for calculi and more and more do we depend upon it. It not only shows the location but the number of stones and, if a stereopticon plate, the relative position of the stones. The X-ray has done more than anything else to prevent extensive mutilation of kidneys in the search for stones. We hear less and less of cases where the plate showed no stone and yet one was found at operation. In delivering the kidney care must be taken not to injure it, tear its vessels, or tear the peritoneum. Better work and easier can be done with the kidney drawn entirely out of the wound and this should be one of the steps of the operation unless the dangers outweigh the advantages, as may be the case where there are extensive inflammatory adhesions. Having confirmed the X-ray findings and located the stone, the method of removal must be considered and here three procedures are open to us; each having its advantages in certain cases. They are the opening of the pelvis (pyelotomy), the formal splitting of the kidney a short distance back of its convex border where there are fewest vessels (Kelly), and direct incision immediately over the stone. In the early history of kidney surgery the incision into the pelvis for the removal of stone got a severe setback because it was apparently shown that persistent fistula was much more common than after nephrotomy. Even in 1908, at our last discussion of this subject, although Bevan in his paper advocated its performance where there was a choice,

McCosh and others said they had tried it, but had gone back to nephrotomy as a safer operation. I believe to-day we will agree that pyelotomy is our preference except for the removal of large branching phosphatic stones and small ones lodged high up in the calices. Where the kidney is badly infected, nephrotomy may also be preferable. Henry Morris (*Surgical Diseases of the Kidney and Ureter,* 1901), who claims to have been the first to show that wounds in the kidney substance healed quicker and with less leakage than those in the pelvis, now says (1901) that with proper suturing this is not so. The incision in the pelvis is accompanied by less bleeding when properly done than that through the kidney, gives ample opportunity for exploration and, with improved technic, heals in the majority of cases without a leak or with very little leakage. The injury to the organ itself is far less than in nephrotomy. Care must be taken to incise and reflect the layer of fatty tissue covering the pelvis as shown by W. J. Mayo (*Surg., Gyn. and Obstet.,* April, 1910), and to carefully displace any vessels which may lie in the line of the proposed incision. The incision in the tissue overlying the pelvis should not be in the same line as that in the pelvis itself and the latter should be longitudinal and not extend quite up to the parenchyma.

In opening the kidney along its back as must be done in certain cases, the pedicle must be firmly compressed between the finger and the thumb of the operator's left hand and this compression kept up until the stones are removed and the wound closed by sutures. This is the best method of controlling the rather profuse bleeding which occurs when the kidney is opened. It is unnecessary and in fact futile to attempt ligation of the bleeding vessels in the kidney substance. Catgut sutures applied closely and not tied very tightly will always stop the bleeding and will not do any serious damage to the kidney. I have never used wire for opening the kidney as recommended by Cullen and Derge, nor the transverse incision of Marwedel. Compression of the pedicle by a rubber tube or by rubber-covered forceps may be necessary when the

kidney cannot be delivered, but damage to the vessels by this method of compression is always possible. Care must always be exercised to avoid the breaking of a stone because if any particle is left it will surely increase in size and necessitate another operation or pass down into the ureter and perhaps not out through the urethra. Also every stone shown in the X-ray plate must, like sponges in the peritoneal cavity, be "removed or accounted for." Closure of the pelvic wounds should be neatly done with small catgut on a round needle and the fatty layer which was first reflexed now brought back and sutured in position. This layer will act much as the omentum does in intestinal work. Silk has no place in renal or ureteral surgery.

The third method of removal, and one which deserves more extensive use, is by incision directly over stones which are fixed in the kidney substance or high up in the calices. With the help of the X-rays this procedure is perfectly reliable for an extensive search of the entire interior of the kidney is no longer necessary. At the Pennsylvania Hospital last winter I removed seven stones from a kidney, the stereopticon plate (made by Doctor Bowen) showing each and their relative positions. I removed two stones from the pelvis, four from a pocket in the lower pole, and the seventh from one of the calices near the convex border, making three incisions, each directly over the stones. There was no urinary leakage whatever in this case and I am sure much less damage was done to the kidney by these three short incisions than would have accompanied the splitting of the entire kidney. In a number of other cases where the stone has been located by a good skiagraph, I have used this direct incision with the greatest satisfaction to myself and I believe with the least possible danger and discomfort to the patient. Binnie (*Operative Surgery,* 1911), approving of the plan, says: "It is far less damaging to the kidney to make several clean incisions through its parenchyma and thus extract the calculi with the minimum of laceration and contusion than to endeavor to take them all out through one cut. The latter plan too often

results in the kidney's being converted into a ragged mass lying inside a nearly perfect capsule."

Our methods of drainage are now much simpler and much better than formerly when tubes and gauze were so freely used. The tube by pressure may do harm and should never enter the kidney or pelvic wound unless infection is very bad. The gauze drain resting against the line of suture by its capillary qualities invites leakage as has been learned by us all in intestinal and gall-bladder work. Even when it is desirable, because of pus, to drain the pelvis or kidney, a rubber-covered gauze drain is best. When no such indication is present, but the drain used as a precaution, folded rubber tissue or a small gauze wick enclosed in this material should be fixed at the site of the incision with a very small catgut suture and removed in four or five days or earlier. The fixation at the site desired is necessary as these soft rubber drains easily become displaced in the subsequent manipulations.

Ureterolithotomy.—I was surprised in looking up the history of this operation to find that Ricketts (*Surgery of the Ureters,* Cincinnati, 1908) and others credit Thomas, of Paris, with the first removal of a stone from the ureter in the year 1800, but on looking up the original article (*Recueil Period, de la Soc. de Med.,* 1800, viii, 216), I found that he had removed a mattress needle with incrustations from the *urethra.* Most of the early operations were done for stones lodged in the lower ureter and by the vaginal or rectal routes or else through the bladder. In 1884, Emmet operated successfully through the vagina; in 1887, Ceci removed a stone through the rectum; and in 1885, Cullingworth by the transperitoneal route. Bardenhauer, in 1882, did the first extraperitoneal operation. Other early operators following various routes were Cabot, Twynam, Ralfe, and Godlee, Hall, Fenger, Lane, Tuffier, and Roberts. I think we may say that the operation of removing stones from the ureter became established about 1890.

The operation differs materially with the situation of the stone. One of the common sites of lodgement is within an

inch or two of the kidney pelvis and stones in this position should be dealt with through the usual lumbar incisions and removed at the point of lodgement or pushed up into the pelvis and removed as already described.

The next most common site for ureteral stones to become fixed is in that portion of the ureter which lies between the iliac vessels and the bladder in the male or broad ligament in the female. It is with stones in this situation that we have our greatest difficulty and about the removal of which we probably are most apt to differ. It must be understood that I am talking of stones which are too large or too rough to pass and not of stones which may be made to pass by drinking large quantities of water or by the injection of oil through the ureteral catheter. Where it appears that a stone is of a type that could be made to pass by these measures it is wrong to submit the patient to operation. In all cases which I have operated upon unless the operation was plainly indicated, the less severe measures have invariably been tried first. I believe, however, that we can delay operation too long in trying the simpler methods or in using them where they must appear futile at the start. I am sure too much manipulation with the ureteral instruments may do serious damage to the ureter, especially if the operator is not skilled and delicate in their use and we have all removed kidneys which have been destroyed by obstructing ureteral stones, which should have been extracted long before.

There are four routes of approach to a stone situated between the iliac vessels and the bladder or broad ligament; the sacral, the intraperitoneal, the extraperitoneal, and the combined intra- and extraperitoneal routes.

The sacral operation was first performed by Delbet (*Annals des Maladies des Organs Genito-Urinaires,* 1891, p. 2246), through a lateral incision extending along the coccyx and sacrum and was later improved by Cabot, who made an osteoplastic flap. Although Morris and others have employed this route successfully in a few cases it has never been and probably never will be generally used.

The intraperitoneal or transperitoneal removal of ureteral stones, although the easiest of all the methods, has quite obvious objections and can never be recommended as a perfectly safe procedure. John B. Roberts reported a successful transperitoneal ureterolithotomy before the Association in 1895 (*Transactions Americal Surgical Association,* 1895, xiii, 381). The ureter was sutured and covered with the peritoneum and there was no leakage or no infection. Lane, Kelly, and Desquin also reported early successful transperitoneal operations. Failures through leakage and infection have been reported however, and because of the likelihood of their occurrence this route can never be the one of choice. Still I believe that in certain cases it may be better to choose this method, which can be carried out with the minimum amount of traumatism to the ureter, rather than to pursue a more devious path through which one must work in the dark and do more damage to the ureter. I have never removed a stone through the peritoneal cavity but I can imagine circumstances under which it would be advisable. Bissell (*American Journal of Obstetrics,* 1908, lviii), presents a very strong argument in favor of the intraperitoneal operation especially in women and describes a very good technic. He reports a very successful case in which the wound in the ureter was covered by a peritoneal flap which had been reflected for its exposure and an extraperitoneal drain carried by blunt dissection from the ureteral wound down into the vagina. The operation has much to commend it and I shall feel inclined in a case where the stone is low down in the female ureter to employ it.

The extraperitoneal operation done usually through a muscle splitting incision parallel with Poupart's ligament and about an inch above its outer half or through the rectus sheath, is undoubtedly the ideal one but often its difficulties are such owing, first to the fact that when the peritoneum is dissected up the ureter remains adherent to it, as was first shown by Cabot, and second to the fixation of the stone so low down in the ureter as to render its exposure to sight nearly impos-

sible. Given a fair sized stone lodged just below the iliac vessels this operation is comparatively easy. Fenger says that extraperitoneal ureterolithotomy had been done five times when his paper was written in 1894. In four cases the stone was above the iliac vessels, in three instances near the kidney and in but one case was the stone below the vessels. In this case Twynam located the stone by opening the abdomen, which was then closed, and the operator three weeks later removed the stone through an extraperitoneal incision in the iliac region. The technic of dealing with the ureter after the removal of the stone is considered in the description of the next method of operating.

The combined intra- and extraperitoneal operation has suggested itself to many operators but in the beginning the operation was often done in two stages, the stone being located through the peritoneal incision and later removed extraperitoneally. R. B. Hall (*Medical Record,* October 18, 1890) located a stone by exploratory laparotomy, forced it up into the kidney and removed it through a lumbar incision. The combined abdominal and lumbar operation for stone in kidney had, in 1892, been done ten times with but one death by Thornton (*Manual of Operative Surgery,* 1892). To T. C. Witherspoon (*New York Medical Journal,* May 21, 1904), I believe belongs the credit of doing the first combined operation for stone in the ureter. He explored the ureter from the peritoneal side through a rectus incision, located the stone, dissected up the peritoneum until the ureter was exposed, closed the peritoneum and removed the stone extraperitoneally. In 1905, Erdmann (ANNALS OF SURGERY, 1905, xliii) accidentally opened the peritoneum in doing an extraperitoneal operation and then intentionally enlarged the opening, confirmed the diagnosis, removed the appendix, and then extracted the stone extraperitoneally, while a finger in the peritoneum supported the ureter. In the same year I twice did much the same operation through a rectus (Kammerer) incision (ANNALS OF SURGERY, May, 1906). The operation was so easy as compared with the extraperitoneal method

alone, that I have continued to use it wherever the stone cannot promptly be exposed in the extraperitoneal wound. In 1908, I reported (*Surg., Gyn., and Obstet.*, May, 1908) seven operations for ureteral calculus, in five of which a small opening was made in the peritoneum, which enabled me to at once locate the stone and by pressure bring it up into the extraperitoneal wound where it was removed; in the other two operations the stone was readily located and it was unnecessary to open the peritoneum. Since the publication of the paper in which the details of my first 6 cases (one had stones in both ureters, making 7 operations) are given, I have operated on 7 cases of ureteral stone, in 5 of which the combined operation was done. This makes a total of 14 operations with 10 combined intra- and extra-peritoneal ureterolithotomies. All the patients made good and prompt recoveries. Taking the 10 cases where the peritoneum was opened, there was no peritoneal infection and leakage of urine occurred but in 3 cases, the first two and the last. The ureteral wound was closed with sutures in but 2 cases. The leakage of urine is not dependent on sutures or lack of sutures but on the amount of traumatism which the ureter receives and the kind of drain which is used. I am sure that leakage in my first 2 cases resulted because of the presence of a gauze drain in close contact with the ureteral wound and, in the last case, was due to traumatism because I had considerable trouble in getting a very low-situated stone up into view and the ureter slipped away from the supporting finger in the peritoneum, necessitating a second incision in a very inaccessible portion of the ureter. The stone could never have been removed by the usual extraperitoneal operation. The drain should be of the type already described in connection with pyelotomy.

One of the advantages of the combined method, as practised in my own 10 operations, is the ability to explore thoroughly the entire ureter on the suspected side and a large part of the ureter on the opposite side. Another advantage is the fact that it is unnecessary for exploratory purposes to separate the ureter from its surroundings to any great extent and

that damage to it through rough handling is not likely. The stone can also be much more readily passed up into a healthy portion of the ureter in the combined than in the simple extraperitoneal method. The one objection to this method which can be raised, is the possible infection of the peritoneal cavity. By the exercise of certain precautions I believe this can be reduced to practically nothing. My own rule has been not to open the ureter until the stone has been thoroughly exposed and the ureter fixed in the position desired for incision; and that when the forefinger has once been removed from the peritoneal cavity it is not again inserted. When the stone is removed the sutures, if needed, should be introduced at once and the drain passed down to the ureteral opening. The peritoneum is then closed and the drain brought out at a point as distant as possible from the peritoneal wound.

In certain cases it is difficult to locate the stone, and sometimes to find the ureter by the extraperitoneal route without extensive dissection and a prolonged operation. Attention is called to Case 6, of my first series in which two stones were removed from one ureter by the combined operation and one stone from the other ureter by the extraperitoneal route in thirty minutes; and this was not the result of a habit of operating hurriedly, but rather the result of the easy access to the ureter through the described incision. I do not wish to be understood as advocating the opening of the peritoneum in every case, nor have I practised this (10 times in 14 operations), but in doubtful or difficult cases I do believe that it is a measure which will greatly facilitate the operation, and reduce its complications, especially injury to the ureter. It is unnecessary to repeat the advantages to be derived from the ability to thoroughly explore the entire urinary tract through such an opening. In two of my recent cases I have had more trouble in getting the stone up into view than in any of the others but this was due to the fact that I was dealing with a stone very near the bladder and so fixed that it could not be pushed up the ureter without damage to this organ.

When the stone is situated in the vesical portion of the

ureter in the male and in the vesical or broad ligament portion in the female, other methods than those already mentioned may be employed. The operating cystoscope has now largely supplanted the operation of opening the bladder to gain access to the stones. When the stone can be seen through the mouth of the ureter, the latter can be dilated and the stone extracted or oil injected above it. In the case of a large stone the ureteral mouth should be split until the stone can be removed. Bransford Lewis (*New York Medical Journal,* November 16, 1912), urges the use of the operating cystoscope even where the stone is fairly high in the ureter. He devotes considerable space to the dangers of ureterolithotomy and reports but one case where he has actually demonstrated the removal of a ureteral stone with ureteral instruments. The operating cystoscope is as useful as he implies but it too has its limitations and dangers.

In the female, stones which lie in the broad ligament portion of the ureter can be removed by direct incision through the vaginal wall or by the combined peritoneal and vaginal operation of Bissell, or by the Doyen (*Morris, Surgical Dispensary of Kidney and Ureter, London,* 1901, ii, 530), or the Garceau (*Jour. Amer. Med. Assoc.,* 1907, xlix), vaginal operations. Apparently urinary leakage is quite common after the vaginal operation and it is probably due to the incision being in the floor of the ureter.

RUPTURE OF THE BLADDER.*

WITH REPORT OF THREE UNUSUAL CASES.

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RUPTURE of the bladder is not a common lesion, for that reason most cases have been and should be reported. Several excellent papers, including the statistics of reported cases, have been contributed, during the past ten years, by Alexander,[1] Jones [2] and others.

Most cases are either intra- or extraperitoneal. The latter is commonly associated with fracture of the pelvis, the former is the more common variety. Rarely there may be a combination of both.

Etiologically the lesion is usually due to an injury to a full bladder. A number of cases are recorded where it has occurred during distention for a suprapubic cystotomy, the rectum being at the same time distended by a Peterson bag. This distention is quite unnecessary if the patient is in the Trendelenburg position.

In a very few cases the bladder was not full at the time, but had just been emptied. In such cases great violence is required, and the rupture is extraperitoneal. Routh [3] reported the case of a drunken man, thirty-four years old, whose bladder was ruptured extraperitoneally by a kick in the abdomen one hour after voiding.

Again there may be no external injury. Such cases are called idiopathic ruptures, and usually depend upon some pathologic condition of the bladder associated with the presence of stone, stricture of the urethra or hypertrophy of the prostate. In a bladder thus weakened, and distended,

* Read before the American Surgical Association, May 8, 1913.

[1] ANNALS OF SURGERY, xxxv, 1902, p. 106.

[2] ANNALS OF SURGERY, xxxvii, 1903, p. 215.

[3] Brit. Med. Journ., Sept. 21, 1901, p. 811.

violent muscular effort, especially violent attempts to empty the bladder, may cause its rupture.

Apart from such predisposing conditions idiopathic rupture is rare.

The first case that I report was apparently an idiopathic rupture, without such predisposing conditions.

The patient, a single man, thirty-one years old, was alcoholic and on the previous evening, while bowling, was said to have drunk over a quart of champagne, besides beer. He said that he urinated at midnight and that at about 4 A.M. he was seized with a violent paroxysmal pain in the abdomen, which proved to be due to an intraperitoneal rupture of the bladder, low down on the posterior surface. When I saw him the next day the abdomen was much distended, rigid and tender. He had been twice catheterized and very bloody urine withdrawn. There were no history or signs of trauma, and he consistently denied having had any. The possibility of some trauma, which passed unnoticed on account of the effects of the alcohol, should be considered. But when he returned home, shortly after midnight, he had just voided, so that the supposition that he ran against the newel post, or some such thing, is not a likely explanation, as the bladder was not then distended. Moreover the pain did not come on until 4 A.M. The rupture probably occurred then for it is usually though not invariably followed at once by pain, and often by shock, in intraperitoneal ruptures. A few cases, however, are reported where the symptoms have been delayed for many hours or even days, and in patients under the influence of alcohol the shock may be lacking. Under the conditions present in this case we cannot arbitrarily assume that there was a trauma, but must admit that it was possibly an idiopathic rupture, due to rapid distention, on account of alcoholic excess.

As rupture may occur from violent muscular action of the bladder and the abdominal walls, we may admit the possibility of such a contributing cause, for the bladder wall felt and appeared healthy and distention alone in so short a time is not likely to have caused the rupture.

Frieberg[4] reports an intraperitoneal bladder rupture in a drunken man, from overdistention, without any known outward injury. Sugetinow[5] reports a case of intraperitoneal rupture of the bladder due to heavy lifting. The patient felt a sudden pain, and again on the fifth day, dying on the eighth day. Sugetinow believed that the mucous and muscular coats only gave way at first and the peritoneum on the fifth day. Jones[6] also reports the case of a man who, soon after urinating and defecating, had severe pain across the lower abdomen, with nausea and a desire to urinate. There was no trauma and an intraperitoneal rupture was found and closed. He was alcoholic. Bolton[7] reported a small rupture of the bladder in a man after two days intoxication. There was no history of injury and he woke up with pain in the abdomen. This patient was examined with the finger in the bladder, and no evidence of ulceration or any pathologic condition was found to account for rupture from overdistention.

It is well known that alcoholism predisposes to rupture of the bladder by causing its rapid distention and obtunding its sensitiveness, so that the call to urinate is disregarded. The muscles of the abdominal wall, which guard the bladder from injury, are also relaxed, so that a slight blow on the abdomen is sufficient to rupture the full bladder without leaving any sign of injury and without the patient being conscious of it. In any drunken patient the occurrence of some trauma can never be excluded.

In Case II the lack of any trauma is more definitely established. This patient was also alcoholic but not a drunkard. The case was obscure from the first, trauma was denied and there was no previous trouble with the bladder or urethra. While in perfect health, 6 days before he was seen by me, a man forty-two years old was taken with nausea and vomiting,

[4] Virchow. Archiv., Bd. ccii, p. 268.
[5] Zblatt. f. Frankhtn. d. Hum. u. Sex Organ., 1900, p. 582.
[6] *Loc. cit.*
[7] ANNALS OF SURGERY, xxxvii, 1903, p. 438.

and the next morning with pain and tenderness in the right lower quadrant. Urination was normal. As he had had two previous attacks of pain in the right lower quadrant, with vomiting, etc., the diagnosis of appendicitis was made. When seen by me he was very septic and weak, in wretched condition, stuporous, and hiccoughing continuously. The abdomen was distended and held quiet, and there was a large tender mass in the right lower quadrant. At the operation a very large quantity of ammoniacal purulent urine was found retroperitoneally, extending up behind the kidney and down into the pelvis. The appendix was normal. Subsequently the X-ray revealed no stone and tuberculin tests were negative, so that the usual causes of ulceration and perforation of the kidney pelvis and ureter were absent. Moreover, the urine remained alkaline and, for a time, the greater part of the total urine came from the incision, leaving only 5 to 8 ounces to be voided.

This pointed to a lesion of the bladder and on cystoscopy there was seen behind the right ureter mouth, a crevice extending laterally nearly across the bladder floor. It resembled a "healing scar, as if a rupture might have occurred here." In about three weeks the discharge of urine from the wound ceased, and a later cystoscopy showed the crevice left by the rupture, much shorter.

He made a slow convalescence and is now, two and a half years later, better than he has been for years.

These two cases are of interest in their bearing on the principle, emphasized by Naumann [8] and others, that a normal bladder never ruptures spontaneously, but that such a rupture depends upon pathologic changes in the bladder wall. In Case II we can not exclude the possibility of a pathologic bladder, in Case I, of some trauma. In the case of a man of fifty-five years, reported by Hosemann,[9] who was seized in the night with severe abdominal pain, operation revealed a small intraperitoneal rupture of the bladder. Trauma, drunkenness and overdistention were excluded, hence he assumes

[8] Zblatt. f. Chir., 1911, p. 1344.
[9] Zblatt. f. Chir., 1912, p. 1323.

an abnormal or pathologic bladder, although such cases of rupture are rare. The operation and subsequent cystoscopy revealed nothing abnormal in the bladder.

Rupture of the mucous and muscular layers, giving rise to a diverticulum covered by peritoneum, has been reported by Reid. In case of a previously formed diverticulum rupture of the weakened wall would require less force than is usually necessary to rupture the bladder.

In Case II the idea first to suggest itself is that there was a perforation of an ulcer, tuberculous or malignant, from within, so that it was a case of perforation rather than rupture. The cystoscope, however, failed to reveal any evidence of a diverticulum or of an ulceration, and there were no previous symptoms to suggest them. Alexander [10] has reported the case of a non-tuberculous abscess, following the psoas tendon, which ruptured into the bladder on the left side, and he had seen two cases of appendix abscess which opened into the bladder. According to Alexander the prognosis, in such cases, is good, except in tuberculous abscesses, and is much better when the rupture occurs from without in than in the opposite direction. In this case there was no symptom or sign of the rupture of an abscess into the bladder, no voiding of pus and no disturbance of micturition.

Speaking of spontaneous rupture from overdistention Gross says: "The mucous and muscular coats generally give way posteriorly, where the urine accumulates under the peritoneum as a kind of secondary pouch." And again the "urine may extend as high as the umbilicus and kidneys." Though we have in this case no good evidence of rupture from overdistention, the above description indicates the course the urine took.

The chief interest in Case III also concerns the etiology. There was here a history of trauma.

A man, thirty-six years old, while asleep on a fire escape, fell one story, landing on the buttocks and woke up with supra-

[10] *Loc. cit.*

pubic pain and a desire to urinate. On operation an extraperitoneal rupture was found a little to the left of the middle line. There was no fracture of the pelvis.

Deaver,[11] has reported a case, also walking in his sleep, who fell two stories, landing on the buttocks, and had an extraperitoneal rupture of the bladder, without fracture of the pelvis.

Ashhurst [12] states that the rupture is sometimes caused by counterstroke, as by a fall on the buttocks. My patient drank two glasses of beer before going to sleep, and the bladder was full at the time of the fall. Whether the bladder is burst by the hydraulic pressure from within, which, when the fall is suddenly stopped, expands the bladder in planes at right angles to the vertical axis at the time of the fall, or whether a sudden muscular spasm is produced by the fall, is an open question. There was no direct blow on the bladder in this case, but the mechanism is much the same as in most of those where there is a direct blow over the bladder, without pelvic fracture, *i.e.*, an expanding of the bladder in one plane and a contraction or flattening in the plane at right angles to this.

Another interesting feature in this case was that though the principal rupture was apparently altogether extraperitoneal, there was considerable bloody fluid with a urinous odor in the peritoneal cavity. Also after an injection into the bladder, by the house surgeon, of 6 ounces of saline solution, of which only 3 ounces returned, the dulness, previously noted in the left flank and the left lower quadrant, was noticed to be shifting. On careful examination of the pelvis, in the Trendelenburg position, no intraperitoneal rupture of the bladder and no tear of the peritoneum could be found, though some fluid could be seen beneath the peritoneum. There was, however, what looked like a contusion, with ecchymosis beneath it, on the posterior surface of the bladder. On account of the fluid in the peritoneal cavity a drain was left in the rectovesical pouch, as well as in the prevesical space. The patient made a good recovery.

Kerr [13] reports a case of intraperitoneal rupture in which he was unable to find the rupture, though boric acid solution, injected into the

[11] Annals of Surgery, xxix, 1896, p. 751.
[12] Annals of Surgery, xxxiii, 1898, p. 385.
[13] Annals of Surgery, xxiii, 1893, p. 647.

bladder, was felt to well up in the bottom of the pelvis. Hence similar drainage was employed with a successful result.

Thorndike[14] reported six cases of rupture of the bladder, in two of which the opening could not be found. The wounds were drained and both patients recovered. In extraperitoneal ruptures failure to find the rupture is more common, and I know of such a condition in an unrecorded case.

In only one of the three cases was injection of a measured quantity of fluid used to confirm the diagnosis. When followed by operation without delay there is little danger. The fluid is sterile and so is the catheter. The danger lies in the carrying in of infection from the urethra in some cases. Hence the danger is about equally great in simple catheterization. In most cases the injection is unnecessary and in a few cases it has proved unreliable. Thus Bolton[15] reports a case where the small intraperitoneal opening was closed by fibrin, and all the fluid injected was returned by the catheter. Also Turnure[16] reports the case of a 3-inch intraperitoneal rupture in a drunken man, without history of trauma, where the fluid injected was all returned by catheter.

It has been demonstrated that sterile urine does not cause peritonitis. If the urine does not have a free outlet it is liable to become decomposed in time, giving rise to irritation. In several recorded cases the occurrence of peritonitis, or peritoneal irritation, has been delayed a number of days. This indicates that the bladder and its contents are sterile.

In most cases silk has been used to suture the bladder. When silk is used it is important to avoid passing it through the mucosa. This precaution is unnecessary when plain catgut is used. Chromic catgut is strong and durable enough for the muscularis. An additional peritoneal suture of silk or catgut should be added. The Trendelenburg position is of the greatest service in suturing ruptures on the posterior surface.

The bladder may be drained by a permanent catheter, or

[14] Journ. of Cutaneous and Genito-Urinary Diseases, May, 1899.

[15] *Loc. cit.*

[16] ANNALS OF SURGERY, vol. lvi, 1912, p. 807.

the patient may be catheterized frequently or made to void at short intervals. I prefer the permanent catheter for the first few days, unless it is contra-indicated by some infection of the urethra or bladder.

Two out of the three cases recovered. The only case of purely intraperitoneal rupture, a very alcoholic patient, died of delirium tremens and pneumonia on the fourth day after operation.

In 1907 Quick,[17] adding to previous statistics, found a mortality of 41.02 per cent. in 117 cases of intraperitoneal rupture of the bladder operated upon, or, since 1892, a mortality of 24.1 per cent. in 29 cases.

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[17] ANNALS OF SURGERY, xlx, 1907, p. 94.

SARCOMA OF THE STOMACH.*

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SARCOMA of the stomach is sufficiently rare to make it important that every case be reported. I report here one case of sarcoma growing from the posterior wall of the stomach. This patient entered the medical service of Dr. F. C. Shattuck, at the Massachusetts General Hospital with what was supposed to be symptoms of duodenal ulcer. His story, however, was atypical of ulcer. The long continued indigestion, the very great weakness and pallor of the man suggested that a hemorrhage had occurred from a duodenal ulcer. The man was so thin, feeble, pale, and ill, that it seemed wise not to institute surgical treatment at first. He did not improve, but continued to have hemorrhages from the bowel and to get progressively weaker. Finally, as a last resource, a jejunostomy was done.

When the abdomen was opened in order to perform a jejunostomy a correct diagnosis of tumor of the stomach wall, probably sarcoma, was made. The man improved so rapidly in strength and general condition that subsequently it was possible to do a partial gastrectomy. The very rapid improvement in this patient's condition following the latter operation was astonishing. His appetite returned, and he gained in weight and strength.

The patient has been seen during the past year and is known to be perfectly well. I hope to be able to make a further report of the later condition of this patient.

The employment of jejunostomy under such conditions of weakness as have been outlined above is to be advocated. There are cases of chronic ulcer and cases of carcinoma in

* Read by title at the annual meeting of the American Surgical Association, Washington, D. C., May, 1913.

which the employment of jejunostomy as a temporary measure is wise. Jejunostomy under these conditions may make a subsequent operation possible, when if a radical operation were attempted without the preliminary jejunostomy the patient might die.

I have collected all cases of sarcoma of the stomach in readily accessible literature which have been operated upon. In a study of these cases of sarcoma of the stomach certain facts are of interest. The tumor starts usually from the submucosa or muscularis. The mucosa is involved in the disease rather late. The disease is one of young and middle adult life. The posterior wall of the stomach and the greater curvature are most often involved. The orifices of the stomach, cardia, and pylorus are rarely involved. Various cell types of sarcoma are found. Spindle-cell sarcoma is quite common. The tumor may be small or reach even twelve pounds in weight. The growth is rarely secondary. It is ordinarily primary in the stomach. The growth extends either outward into the free abdominal cavity or into the lumen of the stomach as in the case here recorded. There is an absence of cachexia in far advanced cases of this disease; quite a different picture from that of carcinoma.

In the absence of metastases a radical operation appears to hold out even better chances of cure than in carcinoma.

I have appended the bibliography that has seemed to be pertinent to the subject under discussion.

CASE.—J. H. P., a Swede, aged twenty-nine years, occupation a composition floor-layer, entered the Massachusetts General Hospital on May 1, 1912. He was a private patient of Dr. W. W. Harvey, of Roxbury. His family history was excellent, his father, seven brothers, and one sister being alive and well. His mother was living but had some stomach trouble. The patient had always been strong and well excepting for an attack of typhoid fever "long ago." He chewed 35 cents' worth of tobacco a week. There was no history of venereal disease.

For about two years previous to the patient's entrance to the Hospital he had been troubled with frequent attacks of "in-

digestion" at irregular intervals, which were associated with constipation and slight, not disabling, pain in the right lower quadrant. After eating heavy food the pain increased and shifted to the epigastrium. He had no nausea or vomiting, but raised considerable gas. About four months ago, after an exposure to cold, an attack came on which persisted. There was vomiting every few days, the vomiting coming on from one to four hours after meals, and relieving the pain for several hours. He had never tried soda for the relief of pain. The pain was not colicky or burning, and was never severe. His appetite was fair, and he was able to eat meat, eggs, milk, and gruels, but no heavy foods. His bowels were constipated, but moved daily with castor oil, salts, or enemas. He had grown steadily weaker and had done no work for three months. The last week previous to his entrance to the Hospital he had been in bed because of weakness. The night before his entrance he was taken for the first time with hot, burning pain in the epigastrium after eating rhubarb for supper. He got to sleep about midnight, but was awakened about 4 o'clock in the morning with more of the same pain and vomited about a pint of brown fluid which his doctor said was blood.

The patient had eaten nothing on the morning after the attack, and had not had much pain, but felt weaker than ever. He was not troubled with coughs, headaches, dyspnœa or œdema. A complete physical examination was not attempted, but a superficial examination showed nothing abnormal.

Blood smear: Slight achromia with polynuclear leucocytes.

May 1. White blood corpuscles, 16,000; hæmoglobin, 80 per cent.

May 5. White blood corpuscles, 14,000; hæmoglobin, 80 per cent.

May 10. White blood corpuscles, 16,000; hæmoglobin, 75 per cent.; red blood corpuscles, 4,580,000.

The patient was given nothing by mouth or rectum for two days, and then was put on rectal feeding for three days. During this time he complained of attacks of burning and cramps in the epigastrium which kept him awake at night. The first few days these attacks sometimes terminated in vomiting large amounts of fluid with "coffee grounds" material. The guaiac test for the stool was repeatedly strongly positive.

On the sixth day he was put on first stage gastric ulcer diet and kept on this diet for three days. Each day early in the evening he had an attack of pain and vomited one-third of a basin full of milk, mucus and crackers, almost all he had taken during the day. On the ninth day he was given milk and crackers every half hour, but vomited as before. Visible peristalsis was noted in the right epigastrium. A diagnosis of obstruction at the pylorus was made and an immediate exploratory operation was advised.

At the operation on May 10, a sarcomatous tumor, the size of a closed fist, was found on the posterior wall of the stomach projecting into the stomach cavity. The tumor was rather discrete and showed no thickening about it. There were no definite glands. A jejunostomy was done.

The patient recovered well from the operation and grew stronger, but still vomited frequently at night. On June 25, he was still doing well and had gained sufficient strength to permit of the removal of the tumor.

On June 26, a second operation was done, a partial gastrectomy for the removal of the tumor of the stomach, the jejunostomy being untouched. On June 29, the jejunostomy was disconnected, the jejunal fistula closed, and an anterior gastroenterostomy was done at a point a little distal to the situation of the jejunal opening. Following this operation the patient made an excellent recovery. There was no vomiting and the wound healed rapidly. He was discharged from the Hospital on July 26, 1912.

In December, 1912, the patient reported for examination and appeared to be in perfect health. He weighed 160 pounds, having gained 70 pounds since he left the hospital. He was working regularly as a composition floor-layer eight hours a day. On April 1, 1913, he was reported to be perfectly well.

The pathological report upon the tumor removed on June 26 was as follows:

"Specimen consists of a solid tumor of the stomach, circular, and resembling a doughnut in shape, measuring 4 and 6 cm., with its centre filled with a polypoid mass projecting above the periphery of the tumor. Its surface is smooth, and on section it is grayish white and homogeneous, with spots which are yellowish. There is a wide margin of gastric wall at one end while at the other the free mucous surface is only 5 to 6 cm.

CASES OF SARCOMA OF THE STOMACH OPERATED UPON.

Name.	No.	Sex.	Age.	Kind of sarcoma.	Location in stomach.	Remarks.	Reference.
Capello	1	F.	54	Cystic	.....	Well two years later	Centralbl. f. Chir., 1899, No. 20, p. 609.
Cantwell	2	F.	52	Spindle-cell	Posterior wall	Well eight months. Recurrence	ANNALS OF SURGERY, November, 1899, p. 596.
Billroth	3	..	..	Round-cell	Anterior wall	.....	Wien. med. Presse, 1888, Nos. 4 and 5.
Dock	4	M.	55	Lymphosarcoma	.....	Partial gastrectomy	Journal of the American Medical Association, 1900, xxxv, 156.
Hartley	5	F.	54	Spindle-cell	Posterior wall	.....	ANNALS OF SURGERY, 1896, i, 609.
Schopf	6	F.	..	Lymphosarcoma	.....	Well one year. Gastrectomy	Centralbl. f. Chir., 1899, xx, 609.
Moschcowitz	7	M.	50	Lymphosarcoma	Near pylorus	Well nine months	ANNALS OF SURGERY, 1912, lv.
Yates-Ochsner	8	F.	57	Large round-cell	Posterior wall	.....	ANNALS OF SURGERY, 1906, xliv, 599.
Yates-Ochsner	9	M.	44	Spindle-cell	Posterior wall	Well four and one-half months.	
MacCormick	10	F.	53	Spindle-cell	Posterior wall	Well five months	Scotland Medical Journal, 1906, p. 299.
MacCormick	11	M.	62	Spindle-cell	Posterior wall	Well two months. Partial gastrectomy.	
Bird	12	..	..	Spindle-cell	.....	Lived three years and four months	Intercol. Med. Jour., 1903, p. 78.
Török (Salaman)	13	F.	21	Round-cell	.....	.....	Transactions Pathological Society, London, 1904.
Morton	14	M.	39	Round-cell	Diffuse	Well two years	British Medical Journal, 1899 and 1901.
Miodowski	15	F.	40	Large round-cell	Posterior wall	Died	Virchow's Arch., 1903, p. 156.
Herman	16	F.	60	Myxofibroma	Great curv.	.....	Transactions of the obstetrical Society, 1901, vol. xliii.
Alessandri (Salaman)	17	F.	53	Fibrosarcoma	Great curv.	.....	Mitt. a. d. Grengzeb. d. Med. u. Chir., Band xii, Heft 4.
v. Eiselsberg (Moser)	18	..	..	Fibrosarcoma	Fundus	.....	Deutsch. med. Woch., 1903, pp. 133 and 157.
Moser	19	F.	41	Myxosarcoma	Posterior wall	.....	Deutsch. med. Woch., 1903, pp. 133 and 157.
Moser	20	F.	17	Myxosarcoma	Lesser curv.	Died.	
Mayland and Anderson	21	F.	57	Spindle-cell	Great curv.	Well	ANNALS OF SURGERY, 1910, vol. lii.

"Microscopical examination of sections removed from various portions shows a normal gastric mucosa with tumor lying immediately below. The tumor is composed of elongated spindle-cells and has numerous blood-vessels. In the midst of these long spindle-cells there are numerous eosinophiles. It seems probable that the cells are derived from the smooth muscular fibres.

"Diagnosis: Spindle-cell sarcoma.

"H. F. HARTWELL."

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THE SURGICAL ASPECTS OF PURPURA.*

BY JAMES F. MITCHELL, M.D.,

OF WASHINGTON, D. C.

In the consideration of factors of safety in surgical operations, hemorrhagic tendency on the part of the patient deserves a place of high importance. This tendency may be inherited, natural or acquired; the three chief groups into which pathological hemorrhages fall being hæmophilia, purpuric conditions and those associated with obstructions of the bile ducts.

Hæmophilia is defined as a strange anomaly characterized by often uncontrollable bleeding. The condition may be acquired but is usually congenital. It has been said to be the most hereditary of the hereditary diseases and we are all familiar with those bleeder families in which the tendency can be traced for generations. The mode of transmission and the pathology are both interesting; but the chief surgical importance lies in the fact that in the presence of such a history even the slightest operations should be strictly avoided. When an operation upon such an individual becomes imperative, it should be undertaken only with a thorough understanding of its dangers and after the institution of every possible precaution against bleeding. Among such precautions may be considered the pre-operative administration of calcium salts and foreign serum, painstaking hæmostasis and accurate coaptation of tissues during the operation and firm pressure with careful bandaging after the operation.

In icteric conditions practically the same advice may be given; for death may result from uncontrollable oozing where no vessel of any size can be detected.

Purpura, on the other hand, offers a greater surgical in-

* Read before the American Surgical Association, May 8, 1913.

terest because of its many variations, the widely different symptoms which it presents, the possibility of confusion in diagnosis and certain complications which may demand operation. The term purpura was first applied by the ancients to the eruptions of scarlet fever and measles as well as to hemorrhage into the skin; but has been restricted to spontaneous hemorrhages in the skin and mucous membranes. It represents both a symptom and a disease, and has been referred to by Osler as "That obscure and interesting manifestation of which we know so much and at the same time so little." In distinction from hæmophilia the hemorrhagic tendency is acquired and usually transitory.

As a symptom, purpura may appear in hæmophilia or in scurvy, the three conditions thus in many ways bearing a resemblance. It may occur in any infectious disease and in many other conditions. As a result of the administration of certain drugs, in nervous conditions and from mechanical strain, the eruption is sometimes seen.

A recent case seen in consultation with Doctors Behrend and Reede, which serves as a stimulus for this report, is an example of symptomatic purpura.

CASE I.—A strong, healthy girl, aged fourteen years, nine days ago began to limp and complain of pain in the right hip. The following day she felt chilly, but on the next was able to go to school. On the fifth day of her illness she was seen by Dr. Reede, who found her temperature 103°, marked tenderness in the right iliac fossa, sensitiveness over the whole abdomen and looseness of the bowels. On the sixth day she was brought to the hospital and has remained in about the same condition. Because of the possibility of deep-seated bone infection a surgical opinion was desired. Her temperature when seen at the hospital was 104°, leucocytes, 13,300. Examination of the chest and abdomen was negative except for abdominal tenderness. "Over the great trochanter of the right femur is an area about 6 cm. in diameter, distinctly hemorrhagic, dark purple in color, with a surrounding margin of œdema about 1 cm. wide. This area is slightly tender, elevated above the general level of the skin and is entirely limited to the skin, which can be moved over

the underlying structures. No other purpuric spots are to be found." After this her temperature gradually subsided and was normal for a few days. It then rose again and a definite Widal reaction was obtained by Dr. Russell. She ran a mild course of typhoid fever. The hemorrhagic area sloughed through the thickness of the skin and healed by granulation.

Gangrene in purpuric areas is rare but may occur, as in a case reported by Prentiss, in which a portion of the anterior abdominal wall, the site of hemorrhage, sloughed away. And in Lett's case there was sloughing of purpuric areas on the face, scrotum and other parts.

It is maintained by some that there is no such thing as the disease, purpura, or in other words that it is always a symptom. Nevertheless several forms of the disease are generally recognized, exhibiting different grades of intensity; but all characterized by the special feature of spontaneous hemorrhage into the skin or mucous membranes. There is also close association with urticaria, erythema and angio-neurotic œdema; Osler describing them collectively as the erythema group of skin diseases. The cause of the disease is unknown, nor has it been decided whether the primary change is in the blood-vessels or in the blood itself. Infectious origin has also been claimed. Post-mortem examinations have shown hemorrhages into the mucous membranes and other regions, but nothing to throw any light on the intrinsic cause. The characteristic lesion is hemorrhage into the skin, varying in size, usually round and sometimes covering large areas through the confluence of several hemorrhages. The fresh spots are bright red but soon become purple in color and do not disappear on pressure. The color gradually changes as in an ordinary bruise and finally disappears, leaving no trace. The eruption is more common on the extremities, particularly the legs, and is more marked on the extensor surfaces. When combined with œdema the patches are elevated.

Without attempting to go into etiology or classification, it suffices to state that one variety, known as Henoch's pur-

pura, is most interesting from a surgical standpoint. Attention was first called to this form by Henoch in 1874, though a case had been previously reported. It is characterized by recurrent attacks of purpura and crises of abdominal pain, often accompanied by vomiting and diarrhœa and with arthritic pain and swelling. It is relatively more common in childhood, but may occur in adults. It may begin with rheumatic pains and swelling of the joints and be followed by purpura and colic with vomiting and blood in the stools; or gastro-intestinal symptoms may appear first and purpura and joint conditions follow. Recurrence is characteristic. Fever is usually mild and there is ordinarily a slight leucocytosis. Epistaxis, hæmaturia, and hæmoptysis often occur. The purpuric rash usually comes after the other symptoms and is often unnoticed. The abdominal symptoms having once appeared usually dominate the scene. The pain is colicky in character; does not yield to treatment, and may continue for a number of days. The colic is intense. The abdomen is usually rigid and tender. In the beginning the tenderness is diffuse; but may become localized over some particular area, usually the right lower abdomen, thus suggesting appendicitis. Vomiting is often distressing and constipation stubborn, suggesting intestinal obstruction. The prognosis is ordinarily good, although Pratt reports eight deaths in a combined series of 202 cases. The explanation of the abdominal symptoms, on the basis of autopsy data, is not clear. In view of the findings of Lennander, as to the insensibility of the abdominal viscera and the extreme sensitiveness of the parietal peritoneum, it is clear that simple hemorrhage into the mucous membranes or localized œdema of the intestines would not be a satisfactory explanation, unless these changes should be sufficient to offer an obstruction to the fecal current. With such an obstruction present the explanation would be simple, for we would then have the same dragging on the parietal peritoneum through the mesentery as occurs in obstructions from kinks, bands, adhesions, etc.

The importance of the condition, surgically, then lies in

the fact that the abdominal symptoms may be so striking as to lead one to open the abdomen, and Pratt states that the literature shows at least six patients who have been subjected to an exploratory laparotomy under this illusion. Quoting Osler, he states that "in children with colic the greatest care should be taken to get a full history which may bring out previous attacks either of skin lesions, of arthritis, or of intestinal crises; and secondly to make a most careful inspection of the skin for angioneurotic œdema, purpura, or erythema," and says that "with the exception of one case in which intussusception was found at autopsy, recovery from the colic has occurred in every instance." Osler himself goes further in saying that "it is also to be borne in mind that recurring colic may be for many years the sole feature of this remarkable disease. The colic is the most constant of the visceral manifestations occurring in 25 of my 29 cases. So far as I know it is never dangerous. In no case has death resulted, I believe, from intestinal causes."

I have personally seen several cases in which the diagnosis has been confusing and one in which an actual laparotomy was done under the diagnosis of appendicitis.

Case II.—On March 28, 1899, a little girl, aged seven years, was sent into Johns Hopkins Hospital by an excellent physician, with a diagnosis of appendicitis with spreading peritonitis. Two weeks before she had been successfully vaccinated, since which time she had been indisposed with enlargement of the axillary glands, slight fever and loss of appetite. On Friday last, to-day being Tuesday, the left leg became swollen and painful from the knee to the ankle. This subsided in twenty-four hours. On Saturday morning she complained of intense pain in the abdomen about the navel, more on the right side than on the left. There was vomiting from Saturday until to-day. The vomitus was foul and on one occasion dark as if containing blood. The urine was negative. The bowels moved Saturday with salts and have moved since with no trace of blood. There has been fever and rapid pulse. Examination at the time of admission showed the temperature 100.2°; pulse, 126; respiration, 33; leucocytes, 25,000; face flushed; tongue clean; abdomen

slightly distended and rigid, but abdominal respiratory movements present. There was slight abdominal tenderness, more marked on the right side, but deep palpation was everywhere possible and there was no mass, no dulness and no actual spasm. Over both knees and elbows were numerous purpuric spots varying in size from pin points to 1 cm. in diameter.

The mother of the child gave a history of a similar attack a year ago in which both knee-joints were swollen and painful and said that the child had always been inclined to abdominal trouble; but did not remember any spots until this attack. A diagnosis of Henoch's purpura was made and the condition cleared up in a few days.

It is quite evident that in this case, except for the fact that a thorough examination and a complete history revealed the presence of purpuric spots and the previous occurrence of a similar attack, an operation might have been undertaken.

Osler describes a second similar case admitted a year or so later in the same way. Lichty and Donaldson record two more quite identical ones and another has occurred in my own service.

CASE III.—In 1907, a colored boy, aged about fourteen years, was sent into my service at Providence Hospital with a diagnosis of acute appendicitis. There was a history of two or three days' illness, with slight fever, vomiting and intense abdominal colic, the pain and tenderness being most severe in the region of the appendix. In the examination of the boy there was found a general purpuric eruption over both legs and a diagnosis of purpura was made. No operation was done and a rapid recovery followed. The patient remained in the Hospital as an elevator boy for a year and had no recurrence of the trouble. He gave an old history of rheumatism and there is no doubt that an examination of his legs at the time of his rheumatic attacks would have revealed the presence of purpuric spots and that the case was undoubtedly a true Henoch's purpura.

By permission of Dr. Harrison Crook I am enabled to record a case in which the appendix was removed.

CASE IV.—A boy, aged twelve years, was admitted to Providence Hospital in the service of Dr. Crook in 1905. He had

been ill for a couple of days with acute abdominal colic, slight fever and vomiting. There was general abdominal tenderness and rigidity, most marked however in the right iliac region. The symptoms were so suggestive of a mild appendicular attack that Dr. Crook operated and through a McBurney incision removed the appendix. I saw the boy in consultation three days later, Dr. Crook stating that his colic had not been relieved by the operation and that the findings in the appendix at operation did not seem enough to explain his symptoms. "At operation the appendix was congested and its superficial vessels distended. Inspection of the last two feet of the ileum showed that it also presented the same appearance and that the Peyer's patches all seemed enlarged, dark in color and projecting from the surface of the bowel, much resembling the condition seen in typhoid fever." There was no recollection of actual hemorrhage into the peritoneum or viscera, although the whole peritoneum was congested. Examination at this time showed slight abdominal distention with no actual spasm and no sign of peritonitis. The legs were covered with purpuric spots, especially marked on the extensor surfaces, all of small size. There were no spots on the arms or trunk and there was no joint tenderness. A diagnosis of Henoch's purpura was made and the condition cleared up rapidly.

In this case the most striking abdominal finding was the appearance of the lower ileum, and it seems quite possible that, with such a hemorrhage or œdematous condition of the Peyer's patches, there may have been at some point enough swelling of the bowel wall to cause a local paralysis which is equivalent to a local obstruction. With such an obstruction the increased peristalsis of the intestines endeavoring to overcome it would be quite sufficient to cause colic by dragging on the mesentery. Jacobsen had a similar instance in which a hemorrhagic appendix was removed.

During the last two years I have had under observation at intervals a most striking case, which I cannot class as a true Henoch's purpura, but it is certainly a closely allied condition; and on several occasions the symptoms have been so alarming as to suggest the possibility of operative interference.

CASE V.—A girl, aged five years, was seen in consultation with Dr. Blair Spencer in November, 1910. There was a history of abdominal disturbances beginning shortly after birth and at the age of two years there was vomiting of blood. In August, 1909, she had an acute illness with temperature 103°, great abdominal pain and intestinal hemorrhages for several days. She had another attack similar to this in September, 1909, when she was operated upon by another surgeon. No abdominal findings were recorded except "general intestinal distention." After this operation she came under the care of Dr. Spencer and, with careful dieting and hygiene, her condition improved and for a year she was quite well. Again in November, 1910, she had an attack in which bright blood was vomited and she was brought into the hospital. She was in a state of collapse; temperature, 96°; pulse practically uncountable. With the administration of horse serum there was complete cessation of hemorrhage and the child rapidly regained its normal health. Since this time she has had one or two similar, though milder, attacks characterized by vomiting of bright blood and bright blood in the stools. With each of these attacks there have been purpuric spots on the limbs, intense abdominal pain and pains in the joints. In each instance an injection of horse serum has served to check the hemorrhage. During the past year she has been given periodic small doses of the serum and has been free from trouble and is now well nourished and apparently in excellent health.

A review of the recent literature would lead one to take a rather more serious view of the visceral complications than that suggested by Osler and Pratt; for, in addition to those cases which at operation have revealed nothing for which operation was demanded, there are many in which operation was necessary and others in which death has occurred from intra-abdominal causes with and without operation. In looking over these cases one is struck by the fact that the chief seat of the lesions is the ileum, especially its lower portion in the neighborhood of the ileocæcal valve. All grades of lesions can be traced from simple hemorrhage or œdema to

intussusception, grangrene, perforation, peritonitis and death; and from the data obtained on the operating table a clear picture of the pathology can be drawn and the abdominal symptoms readily explained. In the cases of Crook and Burrow there was nothing more than congestion with localized small hemorrhages in the lower portion of the ileum. In the case of Harrington there was a definite ring of œdema in the lower portion of the ileum, causing a local paralysis equivalent to a local obstruction. We can thus readily explain the paroxysmal abdominal pain caused by the intestine attempting to overcome this obstruction and dragging on its mesentery with each contraction. Cook and Mills both saw several similar œdematous rings at intervals along the ileum. Greig suspected intussusception in his case and felt a tumor before operation, but when the abdomen was opened and the tumor delivered it proved to be a great congestion of the lower end of the ileum projecting, as a collar, into the cæcum without obliteration of the lumen.

Intussusception is by far the most frequent and most serious intestinal complication and each step in its production can be seen in the various lesions described in operative reports. It is most often ileocæcal or may be enteric. Numerous cases have been treated by operation either by reduction or resection and Vierhuff reports an instance of one which sloughed and was passed per anum, the patient recovering. Sutherland describes one case operated on for a supposed intussusception and a second in which an unsuspected ileocæcal invagination became gangrenous and its perforation resulted in peritonitis and death.

Nobécourt reports one instance of perforation of the duodenum 15 cm. from the pylorus and Silberman a death from gastric perforation. Aside from these two isolated accidents, lesions seem to be pretty constantly confined to the lower ileum.

In a by-no-means exhaustive review of the literature, I find 19 instances in which laparotomy was performed. Eleven times nothing was found which demanded operation and in

the majority of these intussusception was suspected; 9 of these recovered, 1 died in eight hours, one later of pneumonia and a third in three weeks of nephritis. In 8 cases intussusception was demonstrated at operation, 4 being treated by resection and 4 by reduction, with 3 recoveries by each method. Three were unoperated with 1 recovery, making 11 actual cases of intussusception.

In regard to treatment two points are suggested: (1) the efficacy of injections of serum, and (2) the diminution of peristalsis for the relief of abdominal colic and the possible prevention of intussusception.

In the administration of foreign serum we have a valuable aid in the treatment of hemorrhagic tendency. Human serum is to be preferred; but fresh rabbit or horse serum may be used and in the absence of these the ordinary diphtheria antitoxin will suffice. In Case V of my series, small doses (10 to 15 c.c.) of normal horse serum served to check the hemorrhage during an attack, and under periodic doses no further attacks have occurred. In several hemorrhages of the newborn it has seemed to act as a specific. Successful treatment of purpuric conditions with human serum has been reported by Luton, Wilson, and others.

It is interesting to note from the operative reports that in the majority of instances there is not absolute occlusion of the bowel; also that the intussusception is undoubtedly caused by a primary area of œdema or hemorrhage, usually in the lower ileum, acting as a definite obstruction.

In the presence of abdominal crises we can therefore assume the existence of such an area. By keeping the intestinal tract empty through starvation and gastric lavage and by further lessening peristalsis with small doses of opium, the colic may be controlled and the possibility of the commonest and most serious abdominal complication, viz., intussusception, may be greatly lessened. In case of grave suspicion as to the nature of the abdominal condition an exploratory laparotomy is not greatly to be feared; for of the 12 cases unnecessarily operated on there was only one death which

could be attributed to the operation. The recovery rate where intussusception was found—8 cases with 6 recoveries—is as good as occurs with intussusception from other conditions.

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ANEURISM OF THE INTERNAL ILIAC.*

PROBABLY IMMEDIATELY FOLLOWING A SEVERE INSTRUMENTAL DELIVERY: OPERATION AND PARTIAL CURE.

BY ARCHIBALD MacLAREN, M.D.,

OF ST. PAUL, MINN.

It seems that such a rare condition as an aneurism of the internal iliac should be reported. Matas, in *Keen's Surgery,* in reviewing the general subject of aneurism reports several thousands from the literature and does not give a single instance of internal iliac aneurism. Ericson in a large number reports a single case.

Aneurism is a disease of middle life. R. W. Parker quoted by Eve, in *Park's Surgery,* from a study of the literature only found 15 cases of any form of aneurism under twenty years of age. McGraw in *Transactions of the American Surgical Association,* of 1909, reports 64 cases in young people, compiled from the Surgeon-General's Office.

Case Report.—Mrs. J. J. F., first came under observation, October 4, 1911, with a pulsating tumor in the left pelvis about the size of a tennis ball.

Previous History.—Always well until twelve years of age, when she had what was supposed to be an attack of rheumatism, lasting six weeks, but as it left her with a permanently atrophied left leg, the trouble was probably infantile paralysis; she had a marked sensation of pulsation in her left hip at this time, which slowly disappeared. She commenced to menstruate at fourteen years of age, flowing normally about three days, with twenty-eight days intervals. When a little over seventeen years of age she was married. She promptly conceived and had a normal puerperium. In March of 1911, she was confined. Her labor was very difficult and lasted seventy-two hours, being terminated by a difficult forceps delivery. On the third or fourth day after her delivery she commenced to have severe pain in the left

* Read before the American Surgical Association, May 8, 1913.

partially paralyzed limb, extending from the left hip down into the leg—worse in the calf and ankle; she also had marked distress in the rectum. Her temperature and pulse were normal. She was able to get out of bed on the ninth day. About six weeks after her confinement, she had severe pain and a sense of pressure in the lower left pelvis, which was increased by walking or being on her feet for any length of time. About this time she noticed a sense of pulsation in the region of her left hip. The pelvic distress and pulsation steadily increased in spite of local treatment up to the time of her operation.

Physical Examination.—A well-nourished young woman, aged eighteen years; five feet in height; weight 130 pounds; abdomen and chest normal; atrophied left leg, all muscles weak, but able to walk with a dragging limp. Her reflexes were otherwise normal; Wassermann negative; examination of urine and blood normal. Pelvic examination showed laceration of cervix; uterus normal in size, motility and position, except that it was pushed to the right side of the pelvis by a hard tumor in the posterior portion of the left pelvic cavity. There was a marked impulse in the tumor with each heart beat. With one finger in the rectum and one in the vagina, the pulsation was markedly expansile in character; compressing the abdominal aorta stopped the pulsation in the tumor.

At the end of a month's observation and about six months after her child was born, when it was seen that the aneurism was increasing in size I determined to operate, hoping that I could obliterate the sac, after the plan suggested by Matas. A transverse Pfannenstiel incision was made with the belief that through such an opening one could more easily reach deep into the pelvis. But this was disappointing for I could not at any time during the operation see even a small portion of sac wall. The common iliac was followed to its point of division and the posterior iliac was tied by the sense of touch, with heavy catgut. When the ligature was tightened the pulsation entirely disappeared in the tumor. This operation was done in November, one and a half years ago. She still has a hard indurated tumor almost as large as before her operation, with a very slight pulsation in it, almost as though it were transmitted. This tumor causes her some pain in her left hip, but as she thinks it is decreasing, I have not advised her to have any further operation.

TRANSACTIONS

OF THE

AMERICAN SURGICAL ASSOCIATON.

Meeting held in Washington, D. C., May 6, 7 and 8, 1913.

The President, CHARLES A. POWERS, in the Chair.

ADDRESS OF THE PRESIDENT.

THE INFLUENCE OF THE AMERICAN SURGICAL ASSOCIATION ON THE PROGRESS OF SURGERY IN AMERICA.

The President, DR. CHAS. A. POWERS, of Denver, Col., delivered the opening address, for which see page 1.

FIBROMATOSIS OF THE STOMACH.

PROF. DR. ALEXIS THOMSON, of Edinburgh, Scotland, read a paper with the above title, for which see page 10.

DR. JOSEPH C. BLOODGOOD, of Baltimore, said that he had examined and seen at operation four cases of this disease. The thing which had impressed him most was the fact that in other lesions there is a similar production of connective tissue out of proportion to any known etiologic factor, one of these being in osteitis fibrosa. Another, in slight infections such as acne; again in desmoid tumors. He cited an instance of a patient suffering from leontiasis plastica in which a positive Wassermann reaction was obtained, the patient being treated by salvarsan preparatory to operation. In the four cases he had observed of fibromatosis he was surprised by the absence of adhesions between the peritoneum covering the stomach and the surrounding viscera, and also by the fact that in spite of the enormous increase in connective tissue throughout the wall of the stomach the peritoneal surface remained free.

DR. JOSEPH A. BLAKE, of New York, suggested that the condition of fibromatosis might be due to a very slight infection giving rise to a rather diffuse round-celled infiltration with marked reaction on the part of the tissue to the irritation, and

that the same condition was apt to obtain in places where there are broad tissue planes, as in the neck and abdominal wall.

Dr. T. A. McGraw, of Detroit, cited a case of pyloric obstruction caused by a tumor the size of a hen's egg, the condition being relieved by a gastro-enterostomy with the elastic ligature, the patient living in perfect health for three years. At the end of that time he again developed intestinal obstruction. Operation revealed no adhesions around the stomach, no trace of the original tumor at the pylorus, no palpable glands, but a cancer of the large intestine immediately under the stomach though not in any way connected with this viscus. The patient succumbed to the operation and examination of the sections showed typical scirrhus carcinoma, with cheesy degeneration of the lymphatic glands.

Dr. Howard Lilienthal, of New York, referred to the two-stage operation for pylorectomy, first a gastro-enterostomy and then two weeks later a pylorectomy, stating that he was convinced that in at least two instances by following this procedure he had saved the patient from the necessity of the second operation. He therefore recommended that in performing operations for the relief of pyloric obstruction where there are no distinct metastases, the two-stage method be followed.

Dr. J. M. T. Finney, of Baltimore, stated that he had operated on cases of fibromatosis, doing simply an exploration or a palliative gastro-enterostomy, with the recovery of the patient and the disappearance of the tumor. He also cited a case of spontaneous cure without operation.

Dr. Charles N. Dowd, of New York, referred to a case of perforated gastric ulcer in which it was impossible to do a gastro-enterostomy because of the excessive infiltration, but in which two weeks later the infiltration had entirely disappeared. He mentioned a case treated by the two-stage operation, a big tumor being found at the first, and its disappearance at the second, but notwithstanding this the patient died of cancer.

Dr. George W. Crile, of Cleveland, reported a case in which he performed a gastro-enterostomy for supposed cancerous condition, but which later proved to be syphilitic.

Dr. Rudolph Matas, of New Orleans, stated that simple fibromatosis of diffuse type was a very rare condition. He also called attention to the fact that in the pathology of elephantiasis,

which is a fibromatosis of the subdermal tissues, there were a great many analogies to this diffuse progressive form of fibromatosis encountered in the stomach. He referred to a case suffering from fibromatosis which was operated on under the impression that it was cancer, the mistake being discovered at autopsy.

Dr. Arpad G. Gerster, of New York, referred to a case of excision of a pyloric tumor diagnosed as carcinoma, where in the removal he found that he had cut through a substance very much resembling malignancy and therefore feared he had not made a wide enough excision, but on microscopical examination, although the body of the tumor was proven carcinoma, the surrounding material was a simple fibromatosis.

Dr. William B. Coley, of New York, declared that in his opinion the clinical signs with regard to these tumors of the pylorus are of more value than the microscopical report if the latter prove negative for malignancy, and cited a case in point operated upon by Dr. Mayo in which the clinical diagnosis was carcinoma, the pathologist failed to find any trace of this condition, yet the patient died two years later with general carcinomatosis.

DIAGNOSIS AND TREATMENT OF FRACTURES INVOLVING THE KNEE-JOINT.

Dr. John B. Blake, of Boston, Mass., read a paper with the above title, for which see page 27.

Dr. Harry M. Sherman, of San Francisco, did not agree with those who hurried the removal of the splint in fractures of joints, believing immobilization kept up for time sufficient to get solid union was imperative. He did not believe immobilization was the cause of ankylosis but that trauma to the joint itself did result in this condition because of adhesions. To strengthen this argument he referred to the long splint life of children with tuberculosis hip-joints in which absolutely no ankylosis resulted. With regard to passive motion, he argued that passive motion which produced pain produced trauma and should be guarded against.

Dr. Charles L. Scudder, of Boston, said that one should be guided, according as to whether the fragments had been reduced and the articular surface restored to the normal, in one's judgment regarding the time of relieving immobilization and beginning passive motion, calling attenton to the fact that a longer

time is required where there is a large amount of callus, as in incomplete reductions. He also believed that immobilization did not cause ankylosis but that lack of reduction did.

Dr. George E. Armstrong, of Montreal, referred to the conclusion of the British Medical Association that the functional result in fractures is very largely dependent upon the anatomical result. He stated that there was but a slight tendency on the part of fractures to displacement after being once properly replaced, and stated that while in many cases the use of a foreign body was objectionable, his method of notching the ends of the bones even in spiral or oblique fractures would hold them in accurate position. He also said that in two cases he had made a dowel from a small portion of the crest of the tibia, inserting this into the medullary canal of the upper and lower fragments of the broken bone, and that this piece of living bone had done much to stimulate and increase repair.

Dr. Willy Meyer, of New York, called attention to the treatment of fractures of the elbow-joint proposed some fifty years ago by William Busch, who insisted that if the elbow be placed in three positions stiffness would not result. First, in the obtuse position in which the patient usually holds the arm when he presents himself for treatment, for ten days; then with a whiff of anæsthetic, conducting the arm slowly to the sharp right-angle position, keeping it there for ten days; finally, with another whiff of anæsthetic very slowly bringing it into the straight position with a splint on either side encased in a flannel bandage. He has had most satisfactory results with this treatment.

Dr. Henry B. Delatour, of Brooklyn, reported that in the last nine years he had had 78 fractures of the patella, all operated, with mortality of one; this was due to delirium tremens. Two cases of simultaneous fracture of both patellæ; in one case one patella operated on, then 12 days later the other patella: in the other case both operated upon at the same time. Method of operation employed was suture with chromicized catgut, particular attention being paid to the tear in the ligament. No drainage. Plaster splints from toes to middle of thigh for 10 days, then division of splint to leave a posterior splint, patella moved laterally at this dressing when the sutures are removed, and the posterior splint retained for three weeks; then removed at night, or in daytime, thus allowing the patient some passive motion in bed without any strain directly on the patella. No movements of

the joint by the surgeon until after the fourth week. In only two of the 78 cases did he encounter trouble in getting motion; these two patients gave a previous history of rheumatism, and eventually good motion was obtained. Subsequent fracture of the opposite patella in four cases; refracture of the same patella in two cases. Dr. Delatour said that in compound fractures where he had used the Lane plate he had always had to remove the plate, and therefore he now inserted an ivory plate which never required removal.

Dr. Arpad G. Gerster, of New York, sounded a note of warning in the too great eagerness to follow the open method in fractures, and reported in detail a fatal case occurring in spite of the most careful precautions.

Dr. James E. Moore, of Minneapolis, considered that keeping the injured member quiet long enough to allow nature to bring about a natural healing in the bone, by letting the patient exercise it himself afterward, the greatest number of good results would be obtained. He considered it more important to treat most carefully joints in adults than in children with regard to the after-treatment. Great difficulty is sometimes encountered about the knee-joint after fracture of the neck of the femur in old people, and in such cases he advocated passive motion to the knee-joint.

Dr. Charles N. Dowd, of New York, said the results in bone injuries in children are much better than in adults, and that these results in children were much the same whether treated by the most improved or by the old-fashioned methods. He therefore emphasized the point that interference in children is not as necessary as in similar injuries occurring in adults.

Dr. John B. Murphy, of Chicago, said that the cause of most of the trouble in fractures of the elbow-joint was the luxation backward of both condyles; that this was more common than was supposed, and that it was absolutely essential that a differential diagnosis between fracture of both condyles and of only one condyle be made before treatment was instituted. In double fracture, dressing in full flexion, using the arm as a splint for the forearm, will bring the two condyles forward to a safe position. He emphasized also the point that when exercising a fracture it should never be carried to the point of causing pain to the patient.

Dr. John Bapst Blake, of Boston (in closing), stated that he had not infrequently encountered cases of fracture of the

tuberosity in one or two long bones which had been diagnosed as sprains of the knee or rupture of the internal lateral ligament; in the latter case, that of rupture of the ligament, a fracture of greater or less extent should be considered present until absolutely disproved.

ANALYSIS AND STUDY OF 724 MAJOR AMPUTATIONS.

Dr. William Lawrence Estes, of South Bethlehem, Pa., read a paper with the above title, for which see page 39.

Dr. Nathan Jacobson, of Syracuse, considered that as most of the patients enter the hospital in a depleted condition one should promptly overcome that condition by intravenous saline transfusion and overcome shock by early operation. As to amputating through the knee-joint as advocated by the author, he preferred amputation through the upper third of the leg in order to save the knee-joint wherever possible. He reported two cases, one of quadruple amputation necessitated by a roller accident; the other of triple amputation due to contact with a live wire.

Dr. Howard Lilienthal, of New York, stated that in his experience in cases of gangrene due to arterial disease amputation at the knee-joint had been found wanting, gangrene because of deficient blood supply to the flaps being not uncommon: he preferred amputation in either the upper part of the limb or in the lower part of the femur. He stated also that it had been his habit for some years to make skin and muscle flaps rather than flaps of skin alone, in order to retain the nutritional supply, and that this being impossible about the knee, was another argument against selecting this point for amputation.

Dr. William S. Halsted, of Baltimore, advocated that when a patient was greatly shocked from loss of blood and it is not possible to do a transfusion, much benefit may be obtained by catching all oozing points with clamps and placing the patient in a warm bath. With reference to hip-joint amputations he said he had never seen a death from this operation and attributed this to the fact that the patient is in good condition before operation and no Wyeth pins are used, the operation being made absolutely bloodless by the use of clamps.

Dr. F. W. Parham, of New Orleans, advocated the advantage in some instances of using spinal anæsthesia, stating that he had resorted to this method in several cases with good results.

Dr. Alexis Thomson, of Edinburgh, suggested the advisa-

bility of performing major amputations in two stages, first blocking the nerves and dividing them, tying the arteries and subsequently the veins, and then at a second operation within two to four days finishing the amputation.

Dr. Willy Meyer, of New York, with regard to the question of anæsthesia in these cases suggested regional anæsthesia by injection of nerve ends, and also considered that intravenous anæsthesia would be worth a trial in such a large number of cases as fell to the author of the paper.

Dr. W. L. Estes, of South Bethlehem (in closing), considered that the fact that amputation at the knee-joint showed less mortality than in the upper third of the leg was sufficient to warrant its employment. He stated, in reference to Dr. Halsted's suggestion of a warm bath, that in many cases with large areas of torn tissue it would be impossible to carry this out because of the liability to sepsis. His method of amputation consists in the gradual dissection of the part without the use of Wyeth's pins; there is very little bleeding, and the after results are very good. So far as the two-stage operation was concerned he thought this should be taken into consideration, but in his opinion the dread on the part of the patient of a second operation far outweighed in effect the good results claimed for it.

CONGENITAL DISLOCATION OF THE HIP—A RATIONAL METHOD OF TREATMENT.

Dr. Harry M. Sherman, of San Francisco, Cal., read this paper.

He pointed out that in congenital dislocation of the hip, all the components of the joint, femoral head and neck, acetabulum and capsular ligament, are variants, in greater or less degree, from the norms, and that of these the capsular ligament, elongated and narrowed, is the chief obstacle to easy or complete entrance of the femoral head into the acetabulum, while the twisted femoral shaft, which gives the neck and head a forward direction instead of one inward and but a little forward, is the chief cause of reluxation and the assumption of the position called the anterior transposition. Therefore the writer advocates and practises reposition through an incision. This, placed between the tensor vaginæ femoris and the long head of the rectus femoris, cuts no nerves and naught else than connective tissue in exposing and entering the capsular ligament. Through this

incision the narrow part of the capsule is reached and freely cut, and then, in the great majority of cases, in children of proper age, the head can be easily lifted into the acetabulum. Later, to prevent a reluxation, an osteotomy of the femoral shaft is done below the trochanters, and the lower fragment is rotated outward while the upper fragment is held in such a position that the head and neck are properly correlated to the acetabulum as well as to the rotated out shaft. The method of holding the upper fragment, consisting of head, neck and trochanters, is by driving into the shaft, between the trochanters, a suitable steel nail the end of which projects and can be incorporated in the plaster-of-Paris dressing. The method of estimating the functional value of the head and neck and the presence or absence of the antetorsion of the shaft of the femur by radiograms is given, and the character and time of use of plaster-of-Paris splints. The osteotomy is accorded a place of considerable value, for the cases of satisfactory joints, that is, joints that are practically normal functionally, even though they varied from the conventional norm anatomically, was but 41.3 per cent. before the osteotomy became a part of the technic, while 70.3 per cent. of satisfactory joints are secured since the osteotomy is practised in all cases that need it.

Dr. William S. Halsted, of Baltimore, reported a case of a patient operated upon at the age of five years in which he encountered a very small head and a twist of the neck of the femur which made extreme rotation necessary to hold the joint in position, the slightest deviation from this permitting popping out of the head. This child was kept in this position with extreme rotation, the splint being changed every week, for about six months, and now, some twenty years later there is a perfect development of the hip.

THE SURGERY OF THE CARDIOVASCULAR SYSTEM.

Papers were read as follows:

By Dr. Francis T. Stewart, of Philadelphia, entitled: Five Cases of Suture of the Heart; by Dr. Willy Meyer, of New York, entitled: The Surgery of the Pulmonary Artery; by Dr. George Tully Vaughan, of Washington, entitled: Aneurisms Treated by the Matas method; by Dr. Leonard Freeman, of Denver, entitled: Arteriovenous Anastomosis in Threatened Gangrene of the Foot; by Dr. Rudolph Matas, of New Orleans,

entitled: Observations on the Surgery of the Aorta; and by Dr. W. S. Halsted, of Baltimore, entitled: Partial Occlusion of Aorta by Spiral Bands of Fresh Aorta Wall. For these papers, see preceding pages of Annals of Surgery.

Discussion.—Dr. F. B. Lund, of Boston, called attention to the value in these cases of employing the Meltzer-Auer intratracheal insufflation apparatus, reporting a case in which he had used this, the operation being the removal of a sarcoma of the chest wall with three ribs, and in this case, as in others, the result had been most satisfactory. He emphasized the advantage of the employment of this apparatus where the pleura is to be widely opened and where there are no adhesions of the lung to the chest wall.

Dr. Howard Lilienthal, of New York, in reference to Dr. Freeman's paper, said that in arteriovenous anastomoses the technic was of prime importance, and considered it most important to use the very finest needles that can be handled, No. 13 or No. 14, together with 6 0 silk well vaselined. He considered the end-to-end suture the best as it afforded the minimum chance of thrombosis.

Dr. James E. Thompson, of Galveston, cited a case of suture of the heart, in which it was believed that the right ventricle was penetrated; autopsy, however, showed that the wound was in the interventricular septum.

Mr. Alexis Thomson, of Edinburgh, reported a case in which an arteriovenous anastomosis was done first on one side, and at a subsequent time on the opposite side for threatened gangrene; the anastomoses being of the femoral artery and vein at the apices of Scarpa's triangle. This same patient still later developed a hemiplegia and at her own request her common carotid was anastomosed with her internal jugular vein.

Dr. Willy Meyer, of New York (in closing), said that although all agreed that under most circumstances the Meltzer-Auer intratracheal insufflation was indicated, yet there were cases in which the cough reflex was advantageously retained, and that in such cases this apparatus encountered the mouth to such an extent that one of the other pressure apparatuses was indicated.

LARYNGECTOMY FOR CANCER.

Dr. George W. Crile, of Cleveland, read a paper with this title, for which see page 164.

DR. JOSEPH C. BLOODGOOD, of Baltimore, discussed the metastasis in the glands of the neck in laryngeal cancer, referring to cases operated on for cancer of the larynx followed by recovery and subsequently dying from metastasis in the glands of the neck. He emphasized the fact that the inability to palpate these glands is no indication that they are not involved. He also advised that the operation of laryngectomy be done under novocain.

PERIOSTEAL ROUND-CELLED SARCOMA OF FEMUR.

DR. WILLIAM B. COLEY, of New York, read a paper with this title, for which see page 97.

DR. ALBERT J. OCHSNER, of Chicago, reported a case of inoperable round-celled sarcoma of the ilium which was opened, the diagnosis made and confirmed, and the patient treated by the Coley toxins with apparent recovery; two years later a new tumor appeared in the same region, increased rapidly in size; toxins again administered but without effect, the patient succumbing to the condition. Autopsy revealed the fact that the secondary tumor was not a sarcoma but a cyst at the bottom of which was a carcinomatous degeneration. This case convinced the speaker that the same micro-organism is the cause of sarcoma and of carcinoma under different conditions.

DR. WILLIAM H. WELCH, of Baltimore, called attention to the fact that, in the sections examined, apparently different opinions were reached but that in reality this was due to the fact that different portions of the tumor showed different conditions, there being in fact two tumors, a sarcoma and an epithelioma. He considered it unfortunate that the sections of the primary growth are not obtainable in order that a definite opinion might be reached as to whether the recurrence is of the same or a different type of cell.

DR. JOSEPH C. BLOODGOOD, of Baltimore, said in reference to the supposition that the secondary growth in Dr. Coley's case might have resulted from the X-ray treatment, that he had a patient now seven years after a primary and two secondary growths operated upon and treated by the X-ray. He was of the opinion, however, that the result obtained in Dr. Coley's case, of disappearance of the tumor and an interval of ten years before reappearance, justified in inoperable cases the trial of the mixed toxins of erysipelas and bacillus prodigiosus.

Dr. William B. Coley, of New York, drew attention to the fact that although sporadic cures were sometimes noted as of spontaneous occurrence, which rather proved them not to be of malignant nature, he had always had his specimens examined not by one but by several pathologists in order to reach as correct a diagnosis as possible, and that even with such convincing proof of the malignant nature of the cases, he had been able to report various cases as cured by the use of the mixed toxins of erysipelas and bacillus prodigiosus.

SARCOMA OF THE CHEST WALL.

Dr. Fred B. Lund, of Boston, read a paper with the above title, for which see page 206.

CARCINOMA OF THE THYROID WITH INVOLVEMENT OF LUNGS THROUGH THE BLOOD-VESSELS.

Dr. Francis J. Shepherd, of Montreal, read a paper with the above title, for which see page 109.

Dr. Charles H. Mayo, of Rochester, Minn., emphasized the accepted fact that the younger people are affected with malignancy the more rapidly it is disseminated through the lymphatics and the circulation in general, and that therefore the cure of thyroid cancer will as a rule only be in people between 50 and 70, the total removal of the gland being indicated. He also laid stress upon the necessity of an X-ray examination of thyroid carcinoma cases in order to rule out involvement of the chest and lung, stating that no secondary carcinoma of the breast should come to operation without this precaution being taken.

THE SURGICAL TREATMENT OF GRAVES'S DISEASE.

Dr. William S. Halsted, of Baltimore, read a paper with the above title, discussing especially the excision of both lobes, and the ligation of the inferior in preference to the superior thyroid artery, for which see page 178.

HYGROMA CYSTICUM COLLI.

Dr. Charles N. Dowd, of New York, read a paper with the above title, for which see page 112.

Dr. John B. Murphy, of Chicago, called attention to the fact that in hygroma cysticum colli if only a portion of the tumor is removed there is a rapid return with enormous increase in size and secretion, and that these frequently undergo malignant degeneration.

Dr. Joseph C. Bloodgood, of Baltimore, said that he had encountered a number of cysts in the neck lined with endothelium, having no apparent connection with the blood system, and had also seen them in the axilla and groin, occurring without trauma. Three of these cases, which in all number less than 20, have been malignant, evidenced by the presence of blood and papillomatous growths of the cyst wall, these papillomata making excision extremely difficult if not impossible. He advised early removal of hygromata to avoid malignancy, which seems to be a late development.

DIAGNOSIS AND TREATMENT OF BORDER-LINE PATHOLOGICAL LESIONS.

Dr. Joseph C. Bloodgood, of Baltimore, in his paper said that by border-line pathological lesions are meant those in which it is difficult, clinically, or from the gross appearance, or from the frozen microscopic section, to come to a definite conclusion as to whether a lesion is benign or malignant. The earlier after the first symptom patients present themselves for treatment, the greater will be the number of cases in which the diagnosis will present difficulties; in this stage the prognosis after proper treatment is best. It is the opinion of the author that we have sufficient experience at the present time to allow us to formulate definite conclusions as to the proper method of diagnosis and treatment in this stage in which the result should be the best. Incomplete removal of any malignant disease in its earliest stage gives much worse results than complete removal in a later stage; this fact must be always borne in mind. Incomplete removal of a distinctly benign lesion, with the exception of the angioma, is always followed by the reformation of the tumor from the residues left behind, and the chances of malignant change in these residues are greater than in the undisturbed benign lesion; this fact also should be kept in mind.

These border-line pathological lesions, from the standpoint of diagnosis and treatment, can be divided into three great groups.

Group I. In this instance the complete excision of the palpable nodule can be accomplished without danger and without mutilation, so that after its removal it makes little difference what the microscope shows: the proper operation has been done.

Group II. Here also the complete excision of the nodule can be accomplished without danger or mutilation, but there is a

possibility that the lesion may be a carcinoma of a type in which, experience has demonstrated, the neighboring lymphatics should also be radically extirpated.

Group III. In this series the diagnosis of malignancy would indicate a more radical operation with mutilation and, in some instances, increased dangers from the operation, while, if the lesion were still benign a cure could be accomplished with less or no mutilation and less danger.

From his investigations the author is confident that we have sufficient evidence to indicate to the surgeon the proper operation in each group with best results for the patient.

In the first place, the surgeon must have the easily available knowledge of the different pathological processes which may occur in definite localities. He must be familiar with the methods of diagnosis of the lesion in this special region and the nature and extent of the operation which promises the best results. The diagnosis as to the proper treatment rests upon, first a careful study of all the available clinical evidence. In some cases this is sufficient to indicate the proper treatment without a gross or microscopic investigation. This is true for palpable masses in the stomach and colon. The resection of such masses, without an investigation of their gross and microscopic pathology by cutting into them, yields the best results with the least mutilation and danger. If the pathological examination after their removal shows a benign lesion the patient is protected from the later development of cancer; if, on the other hand, it should prove to be malignant, the chances of a cure are best.

As examples of Group I, we may mention benign pigmented moles, warts, small subepidermal nodules, and subcutaneous more or less encapsulated tumors.

In the second group we may mention a lesion on the lower lip. Here the lesion may be radically excised with a V-shaped piece without danger or mutilation, and the wound closed. Then a frozen section is made and if it proves to be a carcinoma of the spinocellular type, the glands under the jaw should be completely removed through a separate incision. This operation in two stages and without continuity dissection has been demonstrated to fulfill all the requirements. With an early lesion on the tongue the method is entirely different, because for the malignant nodule or ulcer the local operation must be more extensive. In a case of this kind, under general or local anæs-

thesia, the palpable area is excised with the cautery and immediately studied under the microscope in a frozen section. If the section shows carcinoma, then the more radical operation must be proceeded with at once.

As an example of Group III, may be used a lump in the breast, one in which a clinical diagnosis is impossible. The surgeon cuts down upon the lump. In the majority of cases the differential diagnosis between benign and malignant is best indicated by the gross findings. In many instances the frozen section is more difficult to interpret than the gross pathological picture. In a few instances the frozen section is helpful, for example, between an intracanalicular myxoma and a medullary carcinoma.

The next important question to answer is, what shall a surgeon do when in doubt after he has exhausted clinical, and gross and microscopical pathological investigation. It is the author's opinion that we have sufficient evidence to answer this question. It rests upon the knowledge of the frequency of malignant disease in the different regions and the results of radical treatment. In the breast, the complete operation for cancer should always be performed for any lesion in a woman over 25 unless the benignity of the lesion is established. The complete operation should follow immediately upon the exploratory incision. This conclusion is based upon the fact that the mutilation of the complete operation is but slight, the additional danger is little if any, while the probabilities of a cure of the malignant tumor, subjected to complete operation in this doubtful stage, is 80 per cent. or more; if the operation is done in two stages the chances of a cure are reduced to almost nothing.

In bone lesions the mutilation of amputation is so great and the chances of a cure of any doubtful lesion, should it prove malignant, are so slight, that the most conservative operation should always be chosen. This is also true for doubtful lesions in the nasopharynx and antrum, on the alveolar border of the jaws, and in the body of the lower jaw.

Dr. Bloodgood is confident that if surgeons will carefully investigate these lesions clinically, scrutinize their gross appearance and look at the frozen sections, and keep a check on their results up to date, they will soon be in a position to meet the requirements of the diagnosis of these border-line pathological lesions inasmuch as immediate treatment based upon this investigation will lead to a removal of the lesion, giving the patient

the best opportunity of a cure with the least mutilation and danger.

As the campaign for the education of the people on the early signs and symptoms of what is or may be cancer bears fruit, surgeons will be called upon more and more to treat these lesions in a stage in which accurate diagnosis is more difficult and where the dangers of incomplete removal, following an inaccurate diagnosis, increase with the space of time between the first signs and symptoms of the disease and the date of treatment.

Dr. John B. Murphy, of Chicago, agreed with the author that the final court of appeal in these cases is the clinical result and not the microscopical report. He reported a case of sarcoma of the patella, the first symptom of which was slight pain on trauma. A month or so later the patient while walking along the street was struck on the patella by a lady's handbag which the owner was swinging in her hand, and this caused him exquisite pain. On operation the condition of sarcoma of the patella was diagnosed, resulting in amputation.

Dr. Charles H. Mayo, of Rochester, Minn., suggested that in border-line pathological lesions where an exploratory operation could not immediately, if necessary, be followed by diagnosis from a frozen section, the wound, even though the condition be considered benign, be packed with Harrington's solution No. 9 for several days until a microscopical report could be obtained. He particularly emphasized the point of not closing such a wound, advocating that it be left open and drained and the lymphatics burned with hydrochloric acid.

Dr. Arpad G. Gerster, of New York, called attention to the possibility of tumors in the breast being either of tuberculous or syphilitic origin, therefore not requiring amputation, referring to many instances, however, where amputation has been performed under the impression that these conditions were malignant. He also spoke of involution mastitis based upon gout, of actinomycosis in the breast, and of the various systemic disorders which may be accompanied by swellings in the breast, emphasizing the point that not all swellings in the breast are necessarily on their way to malignancy.

Dr. Robert B. Greenough, of Boston, said that the hope of increasing the number of cures from malignant disease was based on the patients being seen in the early stages. He advocated that, even in the early stages of suspected cancer of the breast, the whole breast with the pectoral fascia be removed.

THE SURGICAL ASPECT OF PURPURA.

Dr. James F. Mitchell, of Washington, read a paper with the above title, for which see page 258.

Dr. Francis B. Harrington, of Boston, reported an instance in which he had performed a laparotomy presumably for obstruction, but on opening the abdomen an œdematous condition was found, the abdomen closed, and the diagnosis of purpura made.

Dr. Charles A. Porter, of Boston, Mass., likewise reported a case in which a bowel resection was done, the condition later proving to be nothing but angioneurotic œdema.

REMOVAL OF STONES FROM THE KIDNEY AND URETER.

Dr. John H. Gibbon, of Philadelphia, read a paper with the above title, for which see page 232.

Dr. Francis S. Watson, of Boston, said that, in his experience, bilateral calculus had occurred in 30 per cent. of cases and simultaneously in 19 per cent. He had always obtained good results by performing a simultaneous bilateral operation in these cases, and considered this procedure had the advantage of freeing the patient from all his trouble at one sitting. In cases in which anuria is present he considers one is justified in a unilateral operation (both kidneys containing stones) only when the first kidney is seen to be so little damaged that there can be no doubt that it can maintain life by its own unaided functional secretory work.

Dr. Alexander Primrose, of Toronto, Canada, suggested the advisability of opening a dilated ureter at a point slightly above the stone, removing the stone by means of forceps, suturing the wound, and instituting drainage.

Dr. Gibbon (in closing) said that with regard to Dr. Primrose's suggestion it would be impossible to adhere to such a procedure in a case with a mulberry stone without producing unnecessary trauma of the ureter. He agreed with Dr. Watson's remarks in reference to bilateral renal calculi, laying stress upon the point that the stones might also be found in both ureters rather than in the kidney substance itself.

EXCLUSION OF THE BLADDER.

Dr. Charles H. Mayo, of Rochester, Minn., read a paper with the above title, for which see page 133.

Dr. Francis S. Watson, of Boston, reported the case of a patient in one of whose loins he established a permanent renal

fistula by nephrostomy 16 years ago, doing the same operation on the opposite side 9 years ago, and stated that during these many years with the exception of 4 months the patient has been kept perfectly dry, free from odor, comfortable and in excellent health. He devised an apparatus (previously fully described) for receiving the renal drainage. He urged the employment of nephrostomy as being superior in results to ureterostomy stating that the advantage of the more easy performance of the latter procedure was far outweighed by the satisfactory results of the former operation, and described in detail the technic of the nephrostomy procedure. He emphasized the point that in inserting a drainage tube into the kidney it should be carried just within the entrance of the calyx into the renal pelvis, and that care should be taken to avoid having it press too hard against the wall of the renal pelvis lest it cause ulceration; this drainage tube should be of large size, which might make it necessary to stretch or enlarge the mouth of the calyx where it joins the renal pelvis.

Dr. Harry M. Sherman, of San Francisco, reported the progress in a case in which he did the Petersen operation for exstrophy of the bladder in a child of three years, some 12 years ago. The patient has developed most satisfactorily. Five years ago he was operated upon for inguinal hernia, and the speaker thought it was most interesting and instructive to find that even with the absence in this case of the pubic bone the anatomy of the hernia had still been preserved. At this operation he investigated the condition of the ureters in the rectum, found them in excellent condition and with no indication of an ascending infection.

Dr. Robert G. Le Conte, of Philadelphia, considered that experimentation had shown that the extension of infection upward is not through the lumen of the ureter but by means of the lymphatics along the course of the ureter. The longer the anastomosis, or the more ureter covered by intestine in implantation into the intestinal wall, the greater the liability to ascending infection.

Dr. John J. Buchanan, of Pittsburgh, considered the possibility of ascending infection being due to the fact that the cut end of the ureter is in reality the cut end of a mucous canal, which contracts, causing dilatation of the ureter and pelvis of the kidney, and thus predisposing to infection. He also stated

that he believed before one could intelligently deal with this question it would be necessary to learn what effect was produced upon the patient by injection into his rectum of large quantities of his urine prior to operation. He had reached this conclusion after losing a case because of evident poisoning from this source.

SURGERY OF THE PANCREAS.

DR. WILLIAM J. MAYO, of Rochester, Minn., read a paper with the above title, for which see page 145.

PANCREATIC LYMPHANGITIS.

DR. JOHN B. DEAVER, of Philadelphia, read a paper with the above title, for which see page 151.

ACUTE DIVERTICULITIS OF THE SIGMOID IN CHILDREN.

DR. JOSEPH RANSOHOFF, of Cincinnati, read a paper with the above title, for which see page 218.

EXCISION OF THE INFARCT IN ACUTE HÆMATOGENOUS INFECTIONS OF THE KIDNEY.

DR. LUCIUS W. HOTCHKISS, of New York, read a paper with this title, for which see page 226.

RUPTURE OF THE BLADDER.

DR. GEORGE WOOLSEY, of New York, read a paper with this title, for which see page 244.

LEGAL RESPONSIBILITY TO THE SURGEON WHICH THE USE OF THE X-RAY INVOLVES.

DR. ELLSWORTH ELIOT, JR., of New York, presented this paper, which was read by title.

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